SCIENTIFIC AMERICAN

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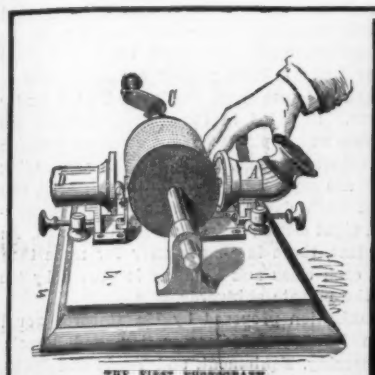

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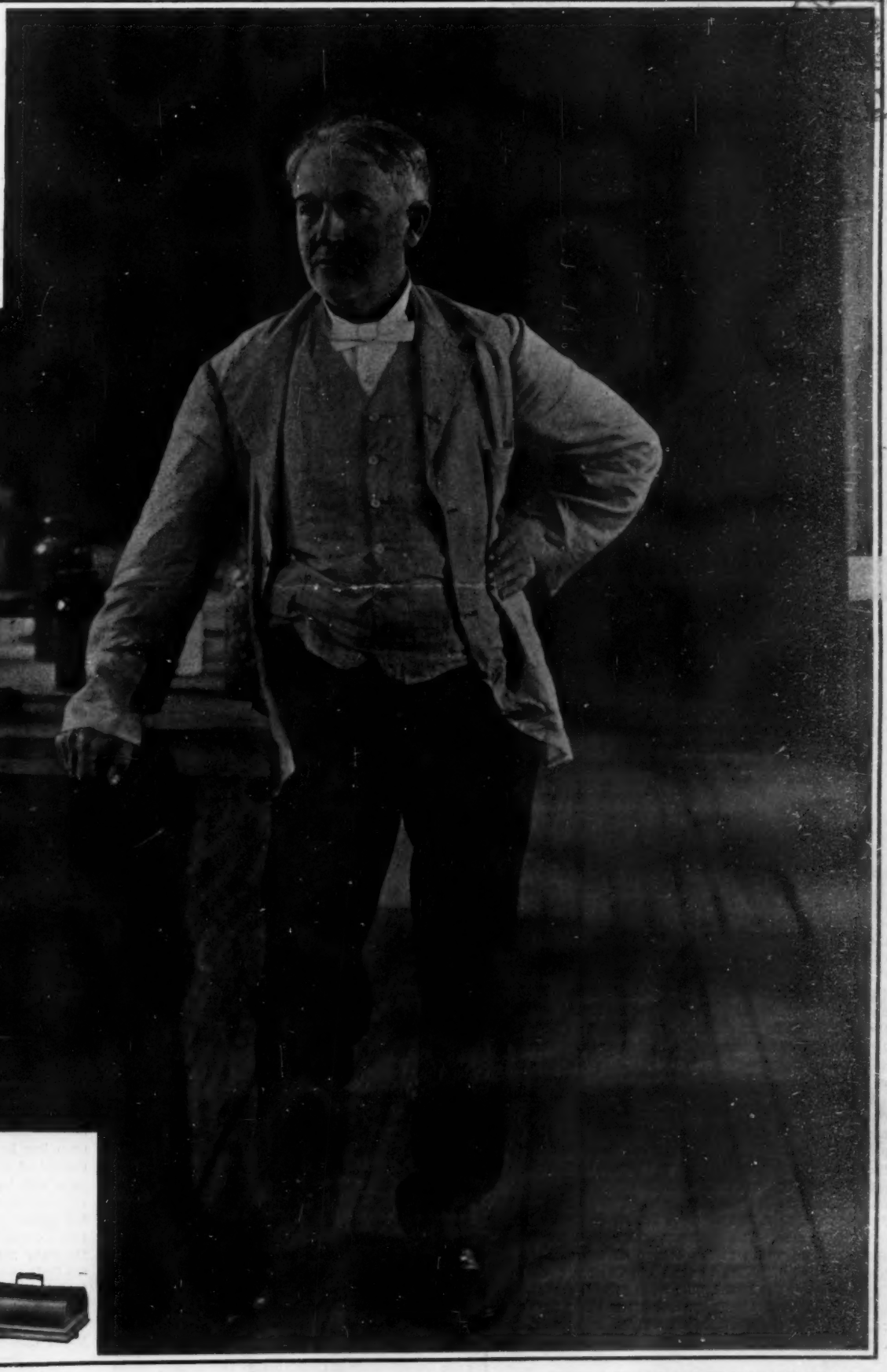

The Latest Edison Phonograph.

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[See page 171.]

Thomas A. Edison

SCIENTIFIC AMERICAN

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NEW YORK, SATURDAY, FEBRUARY 27TH, 1909.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

ENGINEERS REPORT IN FAVOR OF LOCK CANAL.

In the course of his message to Congress accompanying the report of the engineers who inspected the Panama Canal with President-elect Taft, President Roosevelt hit the nail squarely on the head when he stated that any criticism on the present lock plan "is merely an attack on the policy of building any canal at all."

The President's statement is literally true, for the experience already gained in building the very much less costly lock canal proves that the cost of a sea-level canal would be prohibitive. The estimate of the Taft Board of Engineers places the total cost of the lock canal at $360,000,000. Some of this increased cost is due to improvements and enlargements of the original plan, and much of it to the steadily increasing cost of labor and material. To complete the canal at sea level would take, we believe, nearly twice as long as to complete it on the present plan. It is likely that the cost of labor and material will continue to increase as the years go by; and the greater length of time, coupled with this ever-increasing labor and materials expense, would bring the cost of the sea-level type up to at least $500,000,000. It is an open secret that the compelling motive in the construction of this work is the possibility of an acute crisis in the world politics of the Pacific Ocean and the Far East. So swiftly do matters move in this present age, that an international crisis of the first magnitude might easily have arrived and passed, long before the ten years necessary to complete a sea-level canal had gone by.

Furthermore, a sea-level canal carrying a bottom width of only 200 feet for the greater part of its length, would be impossible of safe navigation by the ships of the future, which, many of them, will be not less than 900 feet in length by 110 feet in beam. This would leave but 40 feet of clearance between the ship and the side of the canal; and should a vessel of this length take a sudden sheer in the four or five knot current which would prevail at certain times, due to the 10 feet difference of level of the oceans at each end of the canal, she would be into the bank before she could be controlled. The lock canal will have but 4¾ miles of narrow channel (a sea-level canal would have 40 miles), and for 20 to 30 miles of its length, the ships will be traveling in channels from 500 to 1,000 feet wide and from 45 to 75 feet deep. Because of the higher speed possible in the deeper channels, it will take less time to traverse the lock canal.

The report of the engineers, all of whom are specialists of high reputation in hydraulic work, is a unanimous and unusually strong indorsement of the present lock canal in every feature of its construction. Indeed, the report goes so far as to state that greater caution has been exercised than is strictly necessary, and it suggests lowering the crest of the dam by 20 feet, or from 50 to 30 feet above the level of the water against the dam. The engineers also favor increasing the minimum width at the bottom of the canal for a distance of 4.7 miles through the Culebra cut. In the opinion of the Board, "the work is well organized and is being energetically conducted," and they "see no reason why the canal should not be completed by January 1st, 1915."

DOUBLE-SIDE-DOOR TRAINS ON THE SUBWAY.

The Public Service Commission and the traveling public are to be congratulated on the success attending the use of the double-side-door, experimental train, which has been put in service on the New York Subway. The change, which was made on a regular eight-car express train made up of standard equipment, consists in placing at each end of the car an additional door, located about one door's width from the existing platform door. The new door is operated by pneumatic power, and, when opened, slides into a pocket between itself and the adjoining end door. The extra doors are used by the outgoing passengers, and the old doors by those that board the train. The object of the arrangement is twofold: first, to double the total area of doorway entrances, and secondly, to secure a free circulation by separating the streams of outgoing and incoming passengers.

The placing of this train in service is one of several changes ordered by the Public Service Commission on the advice of its consulting engineer, Mr. Bion J. Arnold, for the purpose of accelerating the movement of trains, and thereby increasing the carrying capacity of the system. With the existing cars, all the outgoing passengers must leave the car before the incoming passengers are admitted. With the new cars, the discharging and receiving of passengers goes on simultaneously. This, of course, means a considerable saving of time; and Mr. Arnold estimates that it will result in increasing the carrying capacity of the whole Subway by twelve per cent. As the Subway has carried on holidays as many as 800,000 passengers in a single day, this would mean an increased carrying capacity of nearly 100,000 people. The total cost of changing all the cars of the road would be about $1,000,000—a very reasonable outlay for such a large increase in capacity.

Unfortunately, the Interborough Company fails to regard the proposed improvement in this light; and the early days of the operation of the trial train seem to have been marked by no little friction between the company's officials and the expert of the Public Service Commission who was placed in charge of the train. The company has raised various objections, claiming that the guards are unable to see the new doors, a difficulty which could easily be met by having special platform attendants to assist in their opening and closing at the proper moment. The company also seems to consider that it would be better to use both doors for incoming and outgoing passengers, instead of segregating the passengers in the manner recommended by the Commission. These, however, are questions of mere detail of operation. The fact remains that on this experimental train the total exit and entrance area has been doubled; the movement of passengers greatly accelerated; and the time of station stops cut in half. "Where there's a will there's a way." The Public Service Commission and the New York traveling public have found the way, and it will be to the interest of the operating company to do everything in its power to promote an improvement of such obvious necessity and importance.

CONSOLIDATION OF THE NAVAL BUREAUS.

The recent attack upon our navy was made along two lines; one aimed at the ships, the other at the organization of the yards at which the ships are built. The SCIENTIFIC AMERICAN, as far as it has engaged in this controversy, has hitherto directed its attention to the defense of our ships, as being the more important element of the controversy. To-day there is no doubt that the public at large, and its representatives in Congress, are satisfied that our ships are at least as good as any that float, and that in the building and manning of a navy we are abreast of the world.

As regards the other question, that of naval administration, we are with the critics in believing that it can be greatly improved by a consolidation of the several bureaus, but we are against them in their proposal that the administration of the bureaus as thus consolidated be placed under a board consisting exclusively of seagoing officers. We believe that the work of designing and equipping our ships should be under the exclusive control of staff officers, carefully trained for this highly specialized and very difficult work; and that in the preparation of the designs, the constructing staff should act in collaboration with the line or seagoing officers to the extent of asking for and carefully considering all suggestions—and there will be many of them—based upon the experiences of these officers when in command of the ships.

In looking through the literature that has appeared during the past few years upon the subject of consolidation, we find that the most comprehensive, practical, and convincing paper is one written by Naval Constructor T. G. Roberts in 1904, and published in the Proceedings of the United States Naval Institute of June, 1905. The present condition as outlined by Mr. Roberts is as follows: The work of the navy yards is done under seven separate bureaus, comprising the Departments of Construction and Repair, Steam Engineering, Equipment, Yards and Docks, Ordnance, Supplies and Accounts, and Medicine and Surgery. The Bureau of Navigation is represented by the commandant of the yard. This division of work is a development of the conditions that existed when warships were built of wood and propelled by sail power. But under the readjustment which followed the introduction of steel and steam into the navy, the bureaus became multiplied and overlapped; so that, to give a concrete instance, the Department of Steam Engineering owns the steam pipes and pumps and engines belonging to the Construction Department; while the Department of Equipment owns the dynamos and the dynamo foundations, if there are any, and the railing around them if it is attached to these foundations. Shipbuilding was originally made up of several professions; but to-day it has merged into a single profession, and it not only includes the production of the whole ship, but it operates the shipbuilding plant, by which it controls the profit which forms the measure of efficiency in industrial administration.

The remedy is the simplest business proposition of this country—consolidation. In a certain navy yard on the Atlantic coast, there are distributed among the various bureaus some seventy shops; thirty-two storehouses under separate roofs; fifty separate piles of materials, and thirteen coal sheds and bins under separate roofs. Included in the seventy shops there are six separate power plants; eight separate machine shops; five separate joiner shops, etc. Corresponding to this outfit are separate sets of foremen, clerks, and draftsmen in each department, aggregating seventy-five foremen, eight clerks, and thirty-six draftsmen. As a matter of fact, there is no necessity for more than one shop of each class and kind, as is proved by the practice of the private shipyards.

The reorganization proposed by Mr. Roberts would combine the Bureaus of Construction and Repair, Steam Engineering, Equipment, and Yards and Docks, under the heading of a new bureau called the Bureau of Naval Construction. The Bureau of Ordnance should remain as now, excepting that its duties should end with the manufacture of ordnance and its shipment to the shipbuilding yard. The bureaus not affected by the consolidation would be those of Supplies and Accounts, and Medicine and Surgery.

"The present necessity," says Mr. Roberts, "is the unification of navy yard industry so that it cannot duplicate itself, and so that naval industrial administration may operate in the full benefit of modern methods as developed with such success in the private industries of this country. All power plants, shops, heads of departments, assistants, draftsmen, clerks, etc., may be combined into one set of each class or kind. The result would effect a reduction of the number of buildings in use, the working forces, and the total cost of the establishment by an amount that would be startling to predict."

The evils of the present system as depicted by this officer, after five years' consecutive experience of them at a particular yard, furnish most interesting reading. The unsystematic method of laying out new yard plants results in an enormous unnecessary expense, due to rehandling and long hauls of material; and a great source of loss lies in the lack of harmony which usually exists between heads of departments. One department owns a crane, a second department is using it, while a third department waits for it. A load of steel plates arrives at a yard, and is removed by one department; another department, which has the list of plates, retains it sometimes for a week or two. When the list arrives, a third department has to inspect them. The first department does not find it convenient to handle the plates until the broken crane of the fourth department is mended. At the end of some months the inspection is completed, and the contractor has lost several months' interest on his money. A drydock and its power plant belong to one department; the operation of the power plant belongs to a second department. Instances of this kind can be multiplied.

Since the designing of a ship is purely a technical-constructive work, Mr. Roberts believes, and we heartily agree with him, that the various bureaus should answer directly to the Secretary of the Navy. To interpose between the Secretary and the constructive staff a "general staff," composed purely of military administrators, whose education, training, and experience has been almost entirely in the operation and control of the ships as built, would be a serious mistake, and tend to reproduce, to some extent, the very evils which consolidation attempts to overcome. Since the Bureau of Construction, even under present conditions, controls one-half of the force and equipment of the navy yards, and under the consolidation, as here set forth, would control over four-fifths, it seems to us that if the consolidated bureaus are to be represented by a single head, answerable directly to the Secretary of the Navy, the officer selected should be the Chief Naval Constructor.

That ballooning is more or less dangerous after all, has again been shown by the dashing of a balloon against some rocks, when the aeronauts were attempting to land, which occurred in France on the 2nd instant, and as a result of which the two men were killed.

ENGINEERING.

But few people appreciate how extensive and valuable are the sources of natural fuel represented by the peat deposits of the United States. According to Prof. Charles A. Davis, who was in charge of the peat researches of the United States Geological Survey, the bogs and swamps of the United States contain nearly thirteen billion tons of peat, representing a value, exclusive of the by-products, of $38,000,000,000.

By the opening of the new tunnel which the Delaware, Lackawanna & Western Railroad has been building through Bergen Hill, N. J., for the last three years, a notable improvement has been made possible in the traffic conditions of that road. As the new tunnel, like the old adjoining tunnel, contains two tracks, the road will now have four tracks available to cope with the heavy traffic of the morning and evening rush hours, and the fine new terminal station can be utilized to its full capacity.

Our naval forces in the Pacific are to be strengthened by the early dispatch to San Francisco of the battleships "New Hampshire," of the "Connecticut" class, the battleships "Mississippi" and "Idaho," which may be called a smaller edition of the "New Hampshire," and the armored cruiser "Montana." This squadron will be followed at an early date by other battleships that are at present on the Atlantic coast, where, before another year has elapsed, our two first "Dreadnoughts," the "South Carolina" and "Michigan," should be in commission.

Extensive tests are to be carried on at the Norfolk navy yard with a new system for cooling the magazines of our warships. After investigating various methods of magazine refrigeration, the navy has installed a system on the battleship "Iowa," and the forthcoming tests will be for the purpose of determining the best temperature at which to maintain the contents of the magazine, with a view to guarding them against such a disaster as occurred recently on the French battleship "Jena." If the results are satisfactory, the system will be installed on the sixteen battleships of the Atlantic fleet.

In our last issue mention was made of the new 14-inch gun being built for coast defense. The Navy Department is also building a 14-inch gun. The naval piece, however, will be of far greater weight and power than the army gun, the former being probably of not less than 2,800 foot-seconds velocity, as compared with the low velocity of 2,150 foot-seconds which has been adopted for the army gun, with a view to preventing erosion and increasing its useful life. High velocity, a flat trajectory, and large remaining energy at distant fighting ranges, are considered to be absolutely essential for an effective naval gun. If the 14-inch piece is successful, it will probably be mounted on our next "Dreadnoughts" of 26,000 tons displacement.

The company that built the Hudson River rapid-transit tunnels has asked permission to extend its two-track system from Thirty-third Street and Sixth Avenue to the Grand Central terminal on Forty-second Street. The opening of this short stretch of road will provide an important link in the movement of passenger traffic across New York city, between the New York Central and New Haven systems and the railroads which terminate in Jersey City. Passengers will proceed by a covered way from the Grand Central station to a new station below the present subway station at Forty-Second Street, where they will be able to take a train direct to the desired main-line terminal in New Jersey.

The recent visit of the "Mauretania" to the dockyard for cleaning and overhauling gave her builders the opportunity to stiffen her after-hull, and to ship a pair of four-bladed propellers in place of those which were lost on previous voyages. The improvement when the ship left drydock was at once noticeable in the absence of vibration and the greatly improved speed of the ship. On her last voyage to the eastward, concluded in very heavy weather, she broke the record by steaming over the long course in 4 days, 20 hours, and 27 minutes, at an hourly average of 25.2 knots, both of which performances are records. A third record was placed to her credit on the second day out from New York, when she logged 605 knots in the 23 hours from noon to noon, which is equivalent to an hourly average of 26.34 knots. On the return trip to the westward, during the first day out from Queenstown the ship covered 671 nautical miles, which is equivalent to an hourly average of 26.84 knots for the 25 hours from noon to noon. This all-day run of the turbine ship, made as it was in the winter season, renders her a very likely candidate for the honor of becoming during the summer months the first ship to cross the Atlantic at an average speed of 26 knots. On the second day out she covered 671 knots; on the third, 647 knots; and on the fourth, 668 knots. The total time for the whole trip was 4 days, 17 hours, and 6 minutes, and the average hourly speed for the whole trip works out as 25.55 knots.

ELECTRICITY.

The practice of renewing broken or exhausted filaments in incandescent electric lamps has grown to such an extent that manufacturers have found it necessary to take out patents for its prevention, both in order to maintain their sales and to prevent damage to their reputation by the insertion of inferior filaments in lamps bearing their trade mark.

Oxybenzyl-methylenglycol-anhydride is the chemical name of a coal-tar product which is being used as an insulator. However, it goes by a trade name of bakelite after the inventor, Dr. L. H. Bakeland. It is stronger than hard rubber, withstands a higher degree of temperature, and is unaffected by most chemicals. It has been used for insulators and also to impregnate soft wood, causing the latter to become as hard as ebony. Generators and motors have been impregnated with the bakelite to protect the wiring.

Some recent information regarding the working of the Stassano electric steel and iron process in Italy is given in an account which the inventor presented at the sixth international congress of applied chemistry held at Rome. He shows that the electric process for steel may be more economical than the use of coal. For coal, the consumption of energy of four horse-power-hours corresponds to 1 kilogramme (2.204 pounds) of coal in the blast furnace. Using hydraulic power, when the price per horse-power-hour is 0.05 franc (1 cent), we have a more economical rate than where coal is at 20 francs ($4) per ton. The newest Stassano furnace has three carbon electrodes which are cooled by water circulation, and the furnace is entirely protected against atmospheric influences, so that it contains only neutral gases. He can obtain with this furnace refined steel direct from the ore, and several analyses showed that this steel was of a good quality.

The supersession of illuminating gas by electric light, which was at one time threatened, was effectively and, it appeared, to the satisfaction of the gas industry, permanently prevented by the introduction of Welsbach or similar incandescent mantles. By their means brilliant lighting was effected at a cost per candle-power actually less than electricity, and in addition the light from groups of incandescent gas mantles was found to have a higher penetration of fog than that of single arc lamps of much higher candle-power. Now, however, it would seem that the so-called "flaming arc" lamp has the latter fog-penetrating quality in a marked degree, and in addition costs only one cent per 1,000 candle-power hours, as compared with 2.3 cents for Welsbach high-pressure gas lighting; so it would seem that gas lighting is again threatened at least with serious competition. The above figures are based on gas at 70 cents per 1,000 cubic feet and electricity at 3 cents per B. T. U.

An interesting type of lightning arrester in use in Italy is described in the current issue of the Electrical Journal. It consists of a series of metal plates, supported over a tank, the latter being provided with an arrangement for squirting jets of water against the plates. These jets provide high-resistance paths for the current to the ground. They are used only during a lightning storm and the flow of water may be adjusted so as to prevent too great a waste of current.

The Boston Elevated Railroad is trying a device invented by the chief engineer of motive power and rolling stock which is adapted to prevent motormen from turning on the current too quickly when starting the car. At each end of the car there is a buzzer connected in a battery circuit and this circuit is closed by means of a solenoid, connected with the main circuit of the motors, when an excessive amount of current is turned on. The motorman is thus warned by the ring of the buzzer when he is not properly operating the controller.

It will be remembered that the Illustration, one of the leading Paris weeklies, installed in its buildings a station for transmitting photographs over a wire, by Dr. Korn's system. Similar stations are established at London and Berlin. In a recent experiment between Berlin and Paris, instead of transmitting a photograph the instrument was adapted to be used for line drawings, and hence the picture was sent much more quickly and the details were clearer. The daily paper Le Matin published a drawing which was thus transmitted, showing the aeronaut Zippel mounted on his aeroplane. The picture published in the Matin is a photograph in which the principal lines have been drawn in ink, but the shades and tints are also visible. A halftone is used for the transmission, and it is rolled in cylinder form. The cylinder revolves and has a small contact wire passing over it so as to send the impulses of current. At the receiving end the usual apparatus is employed so as to give the impression on the cylinder covered with photographic film by means of a spot of light whose brightness depends upon the current. It took about ten minutes to send the above picture, while it would have taken eighteen hours for a photograph to be sent from Berlin by mail.

SCIENCE.

Cornish miners of half a century ago sought for what are known as simple ores and threw aside the complex ones as refractory. In this way they found uranium ore and sent it to the smelters as "black copper" only to have it returned to them as rubbish, and so some 40,000 tons of ore containing perhaps 10 per cent of pitchblende estimated to be worth $2.50 a pound has been found dumped at the head of the Wheal Trenwith mine near St. Ives.

While most of us were busy recalling the life and death of Abraham Lincoln, the New York Academy of Science gathered at the American Museum of Natural History to commemorate the services of Charles Darwin. A bronze bust of Darwin was unveiled and addresses were made by John James Stevenson, professor of geology in New York University; Nathaniel Lord Britton, the director of the New York Botanical Garden, and Hermon Carey Bumpus, the director of the American Museum of Natural History.

The Committee on Congestion of Population in New York has gathered all the necessary material for an exhibit on city planning. Material and data have been gathered to suggest methods for bettering the city's congested portions, and, more particularly, for safeguarding portions of the city at present only threatened with the bad conditions in the older districts. The committee believes that its work, particularly the preventive side of it, is really national in scope, as many cities of not over 50,000 inhabitants are now struggling with congested conditions of population, factories, and offices. Broadly speaking, the lessons in city planning will be readapted from European cities to make them applicable to New York. The general idea is that of having certain classes of buildings restricted to certain neighborhoods. According to the Vienna city plan, factories have certain allotted quarters, in which tenements are not erected. Land in factory districts is necessarily of higher value than in residence sections, so that tenements erected on factory land would have to be overcrowded to make them commercially profitable.

As a result of a lecture delivered by Sir Frederick Treves, the eminent British surgeon, in which he illustrated some practical curative results attained by the use of radium, a British Radium Institute has been founded for carrying out research operations in connection with the application of radium to surgery. In the course of his lecture Sir Frederick Treves recorded the specific cases in which an absolute cure had been effected. He stated that radium can cure every form of nævus; will eradicate the terrible port-wine stain, which is probably one of the greatest disfigurements with which one can be afflicted; and will rid the patient of the pigmented mole and hairy mole. A nævus the size of a gooseberry on the top of the head was completely removed. In another case a girl suffering from a large angioma on her eyelid was rid of the malady by this means when four surgical operations had failed. Possibly the most striking case was that of a young woman who had an angioma covering practically the whole of one side of the face. Repeated operations proved abortive, but under the radium treatment success was soon achieved. These were all affections of the skin. To show that it is equally successful in other cases, a boy who had a fibrous angioma as large as a hen's egg on one arm had it completely dispersed in the course of four weeks. The successful disappearance of a solid mass of such size the surgeon described as marvelous.

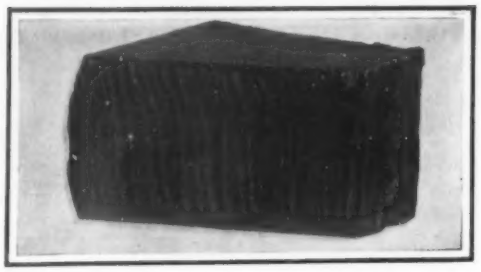
Monochromatic photographs of the sun have been made daily on Mount Wilson since October, 1905, with the Snow telescope and five-foot spectroheliograph. These record the phenomena of a region in the solar atmosphere higher than that previously explored, and reveal the existence of extensive vortices or cyclonic storms associated with sunspots. In general, the direction of rotation of the vortices is counter-clockwise in the northern hemisphere and clockwise in the southern, as in the case of terrestrial cyclones; but a few interesting exceptions, in which the direction of rotation was reversed, have been found. There can now be little doubt that what we see in the telescope as a sun-spot is the mass of vapor, cooled somewhat below the temperature of the photosphere, which lies at the center of an invisible vortex. The discovery of these vortices suggested that the rapid revolution of electrically charged particles, emitted from carbon and other vapors at the high temperature of the sun, should produce a magnetic field in sun-spots. Tests made with the 30-foot spectrograph of the tower telescope show all the characteristic phenomena of the Zeeman effect in the spot spectrum, and leave no doubt as to the existence of a magnetic field. Vortices rotating in opposite directions show opposite polarities, the changes in the spectrum and in the polarization phenomena being precisely similar to those of a luminous source in a magnetic field when the current through the magnet is reversed. The results indicate that the magnetic field is produced by the revolution of negative corpuscles in the vortices.

A "PUTTING-ON" TOOL.

It has long been a joke among engineers and mechanics that there were plenty of machines and tools for cutting off metal as and where required, and that all they wanted was a tool to "put a piece on" wherever wanted. The recent developments of so-called autogenous welding make it seem that the putting-on tool has at last arrived.

In the SCIENTIFIC AMERICAN of May 9th last year was described a method of cutting and welding metals by means of the oxyhydrogen blowpipe. The interest aroused by that article and the number of inquiries received led to investigation as to what America was doing in the same direction, the process above mentioned being a German one, and to the discovery of methods which merit further description, not merely because they have been successfully developed in this country by the Davis-Bournonville Company, but because they represent in several respects a considerable advance over those formerly described.

The German process was simply an application of the oxyhydrogen flame, which has been known for many years as the hottest obtainable, the combustion of a properly proportioned mixture of oxygen and hydrogen giving a temperature of about 4,000 degrees Fahrenheit; the method now under review uses a mixture of oxygen and acetylene, by means



Piece of 2-inch steel plate cut out with oxy-acetylene flame.

of which a much higher temperature is obtained; and as the value of either method is dependent upon the obtaining locally of an extremely high temperature, it is obvious that the latter has the greater possibilities. There are other more technical reasons, which cannot be adequately described within the compass of the present article, favoring the oxyacetylene method principally considerations affecting the efficiency of the burner upon which the operation depends.

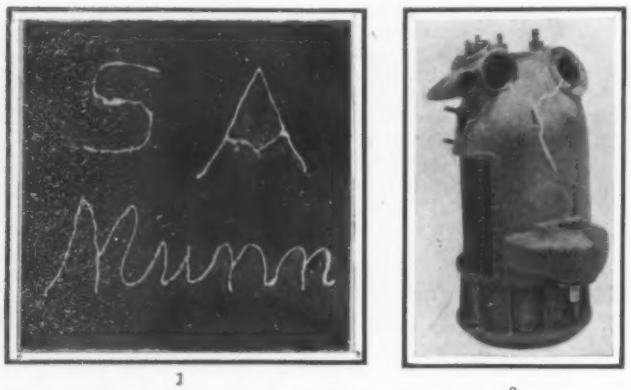
The "torch" of the Davis-Bournonville Company consists of an upper tube carrying oxygen at a pressure varying from 5 to 25 pounds as required, leading into a mixing chamber into which is introduced a lower pipe carrying acetylene at a pressure of one pound. Into the mixing chamber may be screwed a variety of different nozzles having a lengthwise hole, in its passage through which the jet of high-pressure oxygen draws in the acetylene through radial holes around the sides of the nozzle. The proportion of the area of the holes in the nozzle sufficiently regulates the proportionate mixture of the gases, but the latter may be further controlled by cocks upon either pipe. The acetylene pipe is also provided with an enlarged chamber filled with porous material, which prevents any danger of flash-back of the flame into the acetylene supply pipe, and also serves as a handle for the torch.

The acetylene being under pressure, however, the flame is not dependent upon injection for its acetylene supply, and the torch as above described is all that is required for welding. The two pieces of metal to be welded, with no flux or special preparation whatsoever, are simply laid with the edges to be welded together, the jet of flame from the torch is passed along the joint, and the intensely high local temperature generated causes the metals to flow together, and the weld is complete. In most cases it is advisable to add a little of the same metal from a wire or stick carried in the other hand, and introduced momentarily into the flame, as required when it drips off, just as one drops sealing wax onto an envelope.

In this way cast iron may be welded to cast iron, wrought iron, steel, brass, copper, aluminium even, and other metals, or any of them to another piece of the same or to each other.

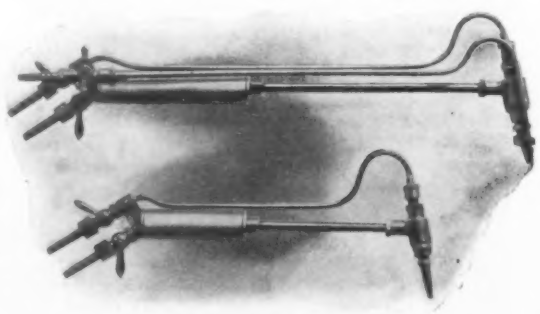
For cutting metals a third pipe is attached to the side of the torch, carrying oxygen at a higher pressure and provided with a separate cock and jet nozzle. After the metal to be cut has been sufficiently heated with the welding flame, the side jet of oxygen is turned on, and the added oxygen completely burns up the metal, the force of the blast carrying the disintegrated metal before it; but so local is the application of the intense heat, that in cutting metal 2 inches thick, the cut is less than ⅛ inch wide, its sides are smooth, and the adjacent metal is not perceptibly injured by oxidation.

For use in portable form the oxy-acetylene process has the great advantage over the oxyhydrogen, that the acetylene has about five times the heating power in proportion to its volume, so that the quantity required to be carried is smaller. For permanent plant the Davis generator, which is approved by the engineers of the National Board of Fire Underwriters, generates acetylene up to 15 pounds pressure by the direct use of lump carbide, from which 5 to 15 per cent more gas is obtained than from the finely-crushed material.



1 2

1. Monogram of the Scientific American and an attempt to "forge" the publisher's signature in half-inch boiler plate. 2. Aluminium automobile cylinder with crack repaired by oxy-acetylene welding.

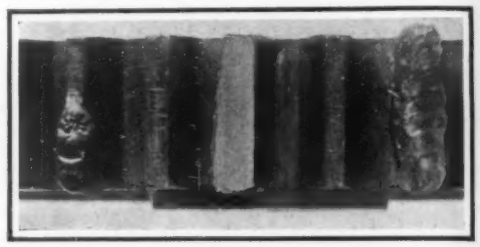


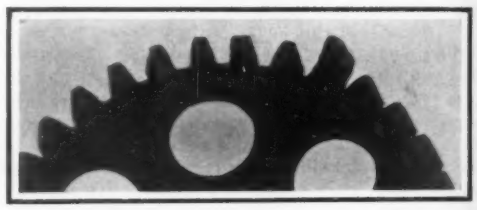
1. Small welding torch. 2. Larger torch with oxygen tube added for cutting.

To illustrate the simplicity of the operation, the SCIENTIFIC AMERICAN representative, with no previous practice or experience, made a serviceable weld between the longer edge of two pieces of wrought iron, 1½ inch by 3 inches and ⅛ inch thick, with much less trouble than he has ever had in soldering a similar joint in thin tin plate. The united pieces were then held in a vise by one edge, and the upper edge bent over nearly double with a hammer, no crack in the weld appearing, nor could any evidence of the joint be shown by file or hacksaw. Similar welds were made between two pieces of cast iron and between cast iron and steel, the united pieces being broken by a blow, and breaking always in the original casting and not at the weld.

The great variety of the applications of such a method is immediately obvious. Locomotive and other boiler tube sheets may be repaired when cracked without removal of the tubes; broken locomotive and car frames may be repaired without the stripping in the shops which causes delay so costly to transportation companies, and the same applies to exterior and other repairs to steamships.

Cracked cylinders and water jackets of automobile and other engines, reparable in no other way, may



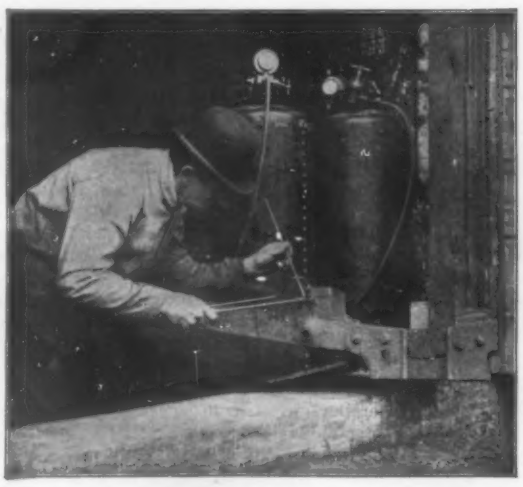


Top and side view of gear-wheel with broken teeth built up.

be made as good as new, saving costly replacement. Tool steel of any desired quality or alloy may be added to common steel or wrought iron exactly where required in the manufacture of special tools or machine parts.

Perhaps the most striking use of the oxyacetylene torch, however, is that which suggests the title of this article. Worn parts of machinery, broken teeth of gear wheels, or any missing piece of metal object may be *built up* of any metal required, and the making of "wasters" avoided in foundry practice by the filling of blowholes and other defects in castings, not with a makeshift and often deceptive substitute, but with metal identical and homogeneous with the rest. The writer saw repaired in a very short time an aluminium gear case, which arrived with a flange broken off and missing. This belonged to an imported automobile, and could be duplicated only in France at a cost of several hundred dollars and a delay of two or three weeks, much more expensive to the owner. The missing part was built up of aluminium, neither joint nor addition being weaker or in any way different from the body of the case, the added part machined as required, and the car in use with the repaired part in place after a lapse of only six days from the time of the breakage, including a journey across country by express of the broken part occupying forty-eight hours each way.

In the gear wheel illustrated above the rebuilt teeth require only machining to be as good as ever. Superfluous metal has been added for effect in one case, but the middle tooth, filed down to the former level, shows no trace of a joint.



Repairing a cracked truck bolster, similar metal being fed from a rod.

Cutting a 20-inch I-beam, the fine spray of burnt metal distinctly visible.

A "PUTTING-ON" TOOL.

THE EXPLORATION OF THE UPPER AIR BY MEANS OF BALLONS SONDES.

BY S. P. FERGUSSON OF THE BLUE HILL METEOROLOGICAL OBSERVATORY STAFF.

In his "History and Practice of Aeronautics," published in 1850, John Wise quotes the following paragraph from an unnamed author:

"Much could be done, however, without great risk or material expense. Balloons from fifteen to thirty feet in diameter, and carrying registering thermometers

An Assmann ballon sonde ready for ascension. Mr. Clayton holding balloon and basket.

and barometers, might be capable of ascending alone to altitudes between eight and twelve miles. Dispatched from the centers of the great continent, they would not only determine the extreme gradations of cold, but indicate by their flight the direction of the regular and periodic winds which doubtless obtain in the highest regions of the atmosphere."

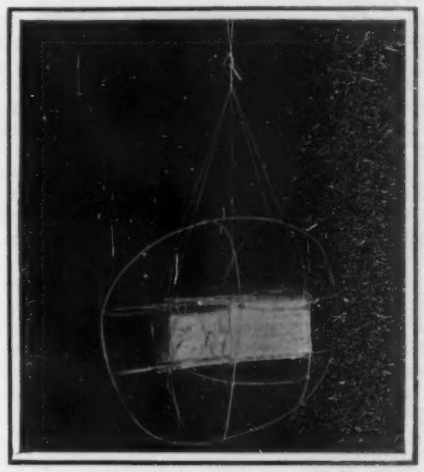
The above suggestion as to the use of balloons in meteorology, although written in the early days of balloons, was not fully realized until March 21, 1893, the date of epoch-making ascension of the balloon "L'Aerophile," conducted by Messrs. Hermite and Besançon of Paris. A very complete description of this experiment was published in L'Aerophile, Vol. 1, by W. de Fonvielle.

Until the first ascension of "L'Aerophile" the highest ascension on record was that of Glaisher and Coxwell in 1862. A height of 11,000 meters was claimed by Glaisher, but a careful analysis of his records indicates that the height probably did not exceed 9,000 meters. Hence, except for the data obtained from measurements of the heights and velocities of clouds, the atmosphere at heights exceeding 3,000 to 4,000 meters remained practically unexplored until within the past twelve years. At the present time, ascensions of the Assmann rubber balloons to heights of 20,000 meters are not unusual, and in a few instances the enormous height of 25,000 meters has been exceeded.

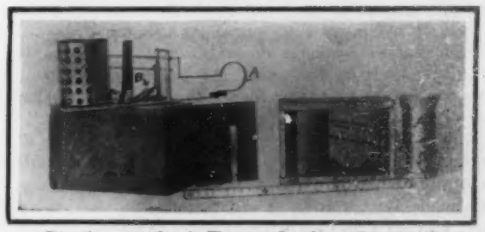
Experimenting with *ballons sondes*, as they were named by the French, is expensive, but was much more so at the beginning than at present. In order to reach a height where the atmosphere is one-half as dense as it is at sea level, a balloon should rise when half full of gas; to reach a point where the density of the air is one-fourth that at sea level, it should rise when one-fourth full. Therefore, to be able to reach very great heights, a balloon made of rigid materials, such as the silk, goldbeater's skin or paper employed in the earlier experiments, must be extremely light and of relatively large capacity, so that it may rise when only slightly inflated. Of the materials named, goldbeater's skin is the best, and silk has been found satisfactory, but both are very costly, consequently the number of ascensions between 1893 and 1897 was not large. In 1898 Teisserenc de Bort devised a simple and inexpensive paper balloon, by means of which he was enabled to make ascensions several times weekly for a number of years at a very moderate cost, the greater part of which was for labor and gas, the balloons being nearly as large as those employed in "manned" ascensions.

The most noteworthy improvement of the new method of sounding the air is the invention of Dr. Richard Assmann, director of the Royal Prussian Aeronautical Observatory. For the large balloons previously employed, some of which contained 500 cubic meters of gas, Dr. Assmann in 1901 substituted a much smaller one made of sheet rubber, which, when filled with hydrogen and sealed, rises until it is exploded by the internal expansion of the gas. The height at which rupture occurs depends almost wholly upon the quality of the rubber, but even under ordinary conditions the heights attained are much greater than can be reached by any other method. The balloons are made in several sizes, ranging from 1,200 to 2,000 millimeters in diameter, and when fully inflated will lift a light parachute and meteorograph and still exert a surplus lift of from one-half to two kilogrammes. The amount of gas required is insignificant —one to four cubic meters of hydrogen—and the entire work of making an ascension can be attended to by one man. The cost in Germany is about $12, $14, and $25 respectively for balloons 1,200, 1,500, and 2,000 millimeters in diameter. Ordinarily, the balloons cannot be used a second time, for in addition to the rupture by internal pressure, the rubber is easily torn by bushes, etc., after the descent. In the Blue Hill experiments one out of every four balloons could be used again, but the rubber was usually more porous than when new, and the heights reached were lower than those obtained by new balloons. Some of Dr. Assmann's balloons were provided with a valve, which was opened by the expansion of the balloon when it reached a height of 8,000 meters. By this means the balloons could be used repeatedly, and the cost of experimenting materially reduced. The superiority of the Assmann balloon, however, is in the excellent ventilation afforded the recording instrument. The rate of rise is rapid, from two to five meters a second, and is nearly uniform throughout the ascent.

The duration of an ascension is generally less than six hours for a paper balloon, and less than three hours for one of rubber. Instruments of the ordinary observatory pattern are entirely too sluggish to record accurately the rapid changes of temperature, etc., experienced during a high ascension of such brief dura



Basket containing instrument elevated by ballons sondes.



Baro-thermograph. A. Thermometric element. B. Bourdon tube barometer. Baro-hygro-thermograph. A. Thermometer screen. H. Hygrometer hair.

Recording apparatus employed in the Blue Hill experiments at St. Louis.

tion, and modifications have been found necessary in order to secure the requisite sensitiveness. Since the beginning the instruments most used have been of the well-known Richard pattern, except that instead of the alcohol-filled Bourdon tube, there is employed a metallic thermometer composed of two thin strips, one brass and the other steel, soldered together in the form of a circle. On account of the difference in expansion of the two metals, changes of temperature cause changes in the curvature of the element, which are recorded upon the clock drum. The barometer for recording the height is usually of the Bourdon-tube pattern, which is more nearly constant in action than the multiple-cell aneroid, though perhaps more liable to deteriorate. In some instances attempts have been made to record humidity by means of a hair hygrometer, but since this instrument is very sluggish at low temperatures, the records are only roughly approximate. Despite the rapid rate of ascent and descent, the heights recorded by most instruments are accurate within one per cent, and the temperatures within one degree Centigrade, ascending or descending. The clock cylinders are made to rotate once in an hour, giving a time scale

NOTICE!

Hydrogen Gas! Keep Away From Fire!

This Balloon was sent up from St. Louis, Mo., for the study of the upper air.
DO NOT OPEN BASKET OR DISTURB CONTENTS IN ANY MANNER. Please pack the BALLOON, CLOTH COVER AND BASKET in a Box or Barrel, and ship by Express, Collect, to one of the Addressees given below. A Reward of Two Dollars will be paid for this service.

If Found BEFORE NOVEMBER 4th, Return to
S. P. FERGUSSON, Care the Aero Club, Kingshighway and Forest Park, ST. LOUIS, MO.

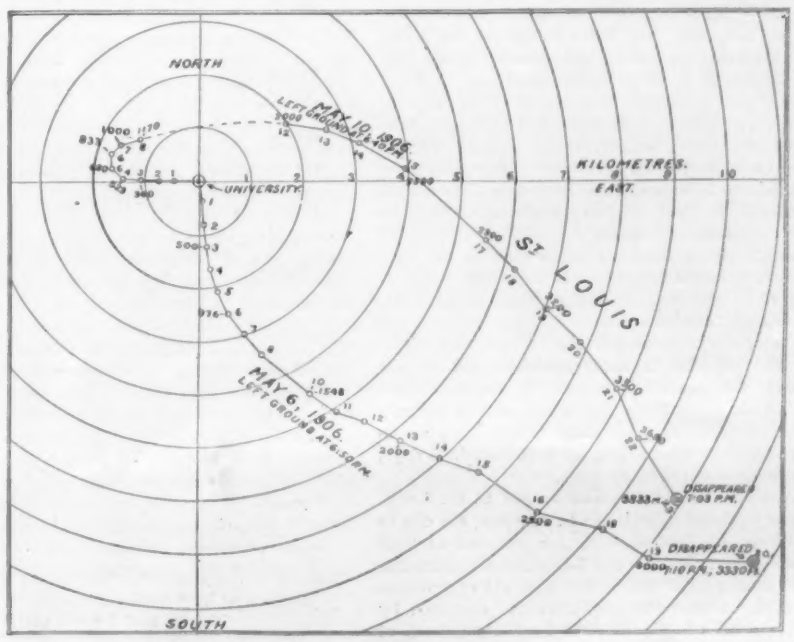
If Not Found until After NOVEMBER 4th Return to
BLUE HILL OBSERVATORY, HYDE PARK, MASS.

Please Fill Out and Mail One of the Cards Inside this Envelope.

Notice on envelope secured to basket.

No. 274 Sent up from St. Louis, Mo., MAY 10, 1906
(12th Ascension.) for the study of the upper air.
Found at Eight miles east of Anna Ills
Date and Time Found May 11, 6 a.m.
Name of Finder Joseph Toler
Address Anna, Ill.
If Found Before NOVEMBER 4th, return this card.
If Not Found until After NOVEMBER 4th, return the other card.

Card returned by finder of balloon sent up May 10th, 1906.



Courses of two ballons sondes liberated at Washington University, St. Louis.

Small circles in the lines indicate times at which observations of altitude and azimuth were made. Figures show minutes elapsing since the balloon left the ground.

of several millimeters a minute, so that readings can be made at least every 20 seconds during an ascension. There has been found no ink capable of withstanding the very low temperatures encountered in the upper air, and the ordinary ruled diagram cannot be used on these instruments. Instead there is employed a thin sheet of aluminium coated with lampblack, upon which the changes in pressure and temperature are traced by minute steel points secured to the recording styles. After the record is obtained, it is fixed by dipping the sheet into a solution of shellac. Since no ruled scales can be used, it is necessary to prepare for each instrument a separate calibration sheet or scale, upon which is marked the amount of displacement of each recording style when the instrument is subjected to definite changes of pressure, humidity, and temperature, measured by means of standard instruments. The pressure scale extends throughout the entire range of barometric pressure, and the range of temperature is usually from 30 deg. above to 80 deg. below zero Centigrade. This test or calibration is made to correspond as nearly as possible with the conditions experienced during an ascension, and in some instances the pressure and temperature are lowered or raised simultaneously. It is necessary to repeat these tests occasionally, in order to detect changes in the condition of the instruments. The operation of reading or measuring the records, when it is done thoroughly, is a very tedious one because of the very small values of the pressure scales. In some instances, at heights exceeding 15,000 meters, a change of height of 1,000 meters is indicated by a movement of the barometric style of less than 0.2 millimeter; hence the need of extreme care in measurement.

The outer casings of some instruments are made of cork, which prevents them from sinking when they fall into water; also, in the newer instruments of Teisserenc de Bort, the cases are of mica, so that every part may be inspected without opening them, and the curiosity of the finder satisfied without unnecessary risk.

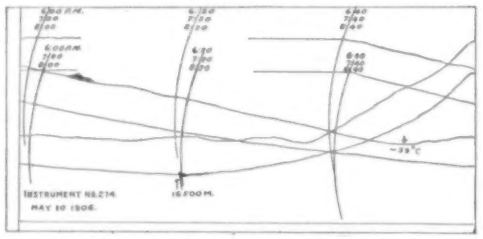
The instruments are secured within a light wicker framework surrounded with large elastic hoops or buffers, which prevent injury as the balloon descends. About the sides of this basket is wrapped a strip of silvered paper, which serves to protect the thermometer from direct sunlight, and by reflecting the light, attract the notice of a possible finder. Also, to secure identification, there is attached a waterproof envelope bearing instructions to the finder to return the balloon and basket unopened, and receive a reward for his trouble. Inside the envelope is a card on which are to be noted the time and place of descent, etc. The basket is suspended four or five meters below the balloon, the suspension cords being secured to a light cotton or silk parachute placed on top of the balloon. This parachute serves to retard the speed of descent after the balloon explodes. Sometimes, instead of a parachute, a smaller balloon only slightly inflated is employed, which does not explode, but after the descent floats a short distance above the basket, and thereby aids in its recovery. The total weight of the 1,500-millimeter balloon, recording instruments, basket and cotton parachute is about 2,450 grammes, or 2,200 grammes if silk parachute is employed. The capacity of this balloon is three cubic meters of hydrogen, having a lift of 3,000 grammes, or an excess over the weight lifted of 600 to 800 grammes. These data refer to the Assmann balloon and the recording instruments of Teisserenc de Bort, but will apply fairly well to apparatus employed by others.

In Europe, except England, more than 95 per cent of the *ballons sondes* liberated are returned; while in America, of 77 sent up at St. Louis, 71, or 92 per cent, have been found and returned.

The use of the *ballon sonde* has become very extensive in Europe, and in many places it has largely superseded the manned balloon in meteorological studies. Also, since the organization of the International Commission for Scientific Aeronautics, ascensions are being made, not only on predetermined days, but according to uniform methods.

The experiments with *ballons sondes* at St. Louis, the first of the kind undertaken in America, are due to the enterprise of Prof. A. L. Rotch, director of Blue Hill Observatory. In 1904 the Louisiana Purchase Exposition made a large appropriation in aid of aeronautics, and of this the sum of $1,300 was expended by the Department of Liberal Arts in the purchase of equipment and in the routine expense of the first experiments, which were conducted by the staff of Blue Hill Observatory. The first ascension occurred on September 15th, 1904; three others were made during that month, and ten others during the best days of the exposition in November. These were so successful that the work was continued in January, 1905, July, 1905, May, 1906, October and November, 1907, the greater part of the cost being paid from grants obtained by Prof. Rotch from the Hodgkins Fund, held by the Smithsonian Institution. The details of the work, including the management of the accessories and the discussion of the records, have been attended to by Mr. Clayton and myself. Since the close of the exposition the ascensions have been made at Washington University, St. Louis, except in October, 1907, when they were conducted at the grounds of the Aero Club of St. Louis, the authorities of the university and the Aero Club having very kindly given all possible assistance to the experimenters.

The results of the St. Louis ascensions show that the velocity of the upper air currents is much greater in America than in Europe. Of the 71 balloons returned, the average distance traveled was 160 kilo-



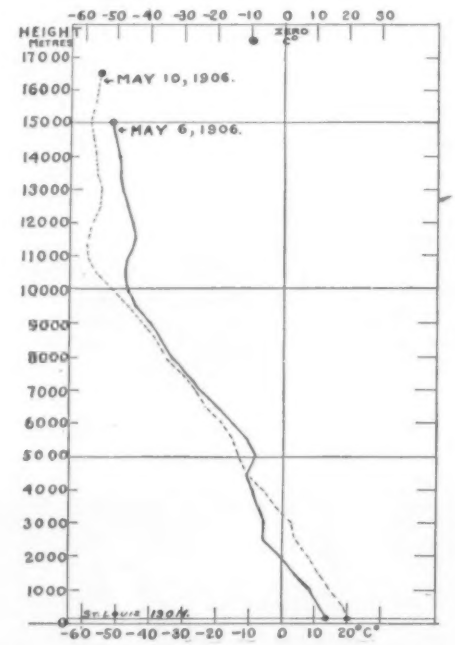
Record obtained May 10th, 1906.

Balloon rose at 6:40 p. m. Greatest height at 8:21 p. m., or 16,500 meters in 101 minutes. At 8:58 p. m. it fell near Anna, Ill., 102 miles from St. Louis, having traveled at 45 miles per hour.

meters, or at an average rate of at least 15 meters a second. The greatest distance traveled was 450 kilometers, at a mean velocity of 46 meters a second. Since the velocity of the wind at the ground was rarely more than 10 meters a second, it follows that in the higher regions of the air velocities of 60 meters a second may be expected at times. The increase of velocity with height is quite well illustrated in the plotted course of the balloons sent up on May 6th and 10th.

Inversions of temperature (that is, an increase instead of a decrease of temperature with height) occur at all heights, but the great inversion or "isothermal stratum," found in Europe at heights of 10,000 to 12,000 meters, also exists in the atmosphere over America. The height of this stratum apparently is greater in southern than in northern latitudes, but its vertical extent is unknown, since ascensions to heights of 25,000 meters have failed to reach an upper limit where the decrease of temperature again becomes normal. This phenomenon is shown in the record of May 10th, 1906, reproduced herewith and in the diagram showing vertical changes of temperature found on May 6th and 10th.

A discussion of some of the data in their relations to movements of storms, etc., was published by Mr. Clayton in the Beiträge zur Physik der freien Atmosphäre in 1906, and the completed results of the entire work have been published with the other Blue Hill



Changes of temperature with change of height. Note beginning of "isothermal stratum" between 10,000 and 12,000 meters.

THE EXPLORATION OF THE UPPER AIR BY MEANS OF BALLONS SONDES.

investigations in the Annals of the Astronomical Observatory of Harvard College.

Heretofore no experiments with *ballons sondes* have been undertaken near the Atlantic coast, for the reason that, even if the ascensions were made far enough inland to prevent loss of the equipment in the ocean, the probable loss, in the large areas covered by swamps, forests, and mountains in this region, would be much greater than in the region east of St. Louis. However, on May 7th and 8th, 1908, two ascensions were made at Pittsfield, Mass., by Prof. Rotch, director, and Mr. Clayton, meteorologist, of the Blue Hill Observatory, in order to test a method, proposed by Mr. Clayton, of limiting the duration of the ascensions, so that in all probability the instruments would fall before reaching the coast. This device consists of a mechanism controlled by a clock, whereby the balloon is released from the parachute at some predetermined time, the parachute and instrument falling to the earth before the balloon reaches its greatest height. By the use of two balloons it was expected that, with the resulting increase of lift, a maximum height exceeding 5,000 meters would be reached before the balloons drifted too far eastward. One balloon sent up on the 8th was found on the same day at Randolph Center, Vt., 177 kilometers N. N. E. from Pittsfield, but the instruments have not yet been reported, and at the present time it is impossible to reach a conclusion as to the practicability of the method or the suitability of the locality for experimenting. Further experiments are expected to yield more definite results.

Correspondence.

THE "REPUBLIC" DISASTER.

To the Editor of the Scientific American:

The writer, who is a constant reader of your paper, found your editorial "Lessons of the 'Republic' Disaster" very interesting and doubtless correct in its conclusions. At any rate the latter appear thus to a layman. He thinks, however, that you are not justified in assuming that the "Republic" was built on specifications of the White Star Company and "therefore represented the most approved methods of steamship construction."

He acknowledges the excellent reputation enjoyed by Harland & Wolff for marine work, but has no knowledge whether or not they build equally as well for one steamship company as another. One would suppose they would build according to specifications and charge accordingly. But the point he wishes to make is this: If not mistaken, the "Republic" (formerly the "Columbus") the "Canopic," and "Romanic" were built for the Dominion Line, and were bought from the latter by the White Star Company five or six or more years ago. At the time they were built they were perhaps not in the same class as the White Star ships launched about that time. They seem to have been rather what might be termed combination craft, provided with relatively large cargo and steerage capacity and of moderate power and speed. Built for general business between Boston and Europe and outside the intense competition existing in the New York service, it seems reasonable to conclude that there was not as much required in the way of speed, comfort and cost as in the case of the New York lines. The change of name and ownership added little to their strength and seaworthiness in case of accident.

W. G. Parsons.

Cambridge, Mass., February 9th, 1909.

Death of Earzm von Jerzmanowski.

Herr Earzm J. von Jerzmanowski, who for many years lived in New York, where he was in the gas business, died on February 12th at Cracow, Austria.

Herr von Jerzmanowski was well known in this city as the introducer of the water process of making illuminating gas, now almost universally used throughout the United States.

After the Polish rebellion he had been exiled from Russian territory. He went to Paris and there took up scientific work under Prof. du Moty. His experiments carried him to the most advanced stages in the commercial application of natural and manufactured gas.

Herr von Jerzmanowski was appointed a captain in the French army during the Franco-Prussian war. He was stationed at Paris. The title of Count had been conferred on his father by Napoleon Bonaparte and fell to him by birth. In 1889 he was honored with the Cross of St. Sylvester by the Pope.

The Current Supplement.

An illustrated description of the new railroad bridge at Vancouver opens the current Supplement, No. 1730. The extraordinary change that has taken place in recent years in the proportioning of screw propellers for turbine steamers is discussed from the engineering standpoint. The question of the amount of heat in steam under various operating conditions, the quantity of this heat available for transformation into work and the various relations of this heat quantity which produce condensation and superheating and other equally important changes in the steam content are treated by Joseph H. Hart. In commemoration of the centenary of Darwin's birth, Prof. David Starr Jordan writes a popular article on "Darwinism, Fifty Years After." The Life History of the White Ant is authoritatively set forth by Prof. K. Escherich. Dr. Robert Fuerstenau writes instructively on the mechanism of the human brain. Arthur W. Ewell explains the thermal production of ozone. A third installment of the treatise on aeronautic motors appears. Other articles worthy of mention are entitled "Glass Brick: A New Building Material"; "The New Reducing Agents Employed in Metallurgy"; "Reaction Propellers for Aeroplanes"; "Recent Progress with the X-rays, and "Earthquake Forecasts."

IMPRESSIONS OF AMERICAN INVENTORS.—I.
THOMAS A. EDISON.

As an inventor, Edison's chief characteristic is his pertinacity. "Genius is two per cent inspiration and ninety-eight per cent perspiration," is an epigram of his, which has been worn threadbare by much newspaper use, but which contains the whole story of his intensely active career. Edison is a utilitarian to his finger tips. He never yet invented a machine that could not be employed in everyday life. Long ago he made a brief excursion into the field of aerial navigation, and although his experiments were full of promise, he abandoned the investigation, largely because there was no immediate prospect of applying the flying machine to the needs of this world. Even his conversation is that of a man whose interests are essentially practical. He would never ramble off, for example, into a metaphysical discussion on man's place in the universe. He is a glorified Yankee inventor, a mechanic of real genius who, by dint of rare patience and indomitable energy, has raised himself to an enviable position among the most distinguished scientists of his time. Despite the exceedingly practical bent of his faculties, he is a man of large ideas with a wonderful gift of what may be termed scientific penetration. Few engineers and physicists can grasp with anything like his swiftness of perception the meaning of simple phenomena, often accidental in their origin. The phonograph, for example, which, although not his greatest invention, is probably the most marvelous in the eyes of the public, was suggested by experiments made with the telephone and automatic recording telegraph. He was working on a machine provided with a disk of paper, similar to the present disk talking machine. On the traveling arm was a magnet which had an embossing point which embossed or indented dots and dashes on the paper, the platen having a grooved volute spiral on its surface. After recording Morse signals a contact point swept over the record, and the indentations gave movement to the make and break and reproduced the signals on another line. When run at high speed, it would give a humming sound. He knew from the telephone about the movements of the diaphragm, and had caused his voice to work a ratchet wheel and toy figure. Then he conceived the idea of indenting by the voice, and reproducing the sound by means of the indentations. The machine was made, but in cylinder form. Then he decided to make a talking machine—with what success every one knows. When the first operative machine was produced, he packed up the instrument and came to the office of the SCIENTIFIC AMERICAN. Without ceremony he placed the machine on the Editor's desk and turned the crank. The machine literally spoke for itself. "Good morning," it said. "How do you do? How do you like the phonograph?" And thus the Editors of the SCIENTIFIC AMERICAN constituted the first public audience that ever listened to the phonograph.

If ever an Edison invention was the product of unflagging pertinacity it was the electric incandescent lamp. Strange to narrate, he began with the metallic filaments, which now threaten to supplant the carbon filament that he finally adopted. He abandoned the metallic filament, not because he failed to see its immense possibilities, but because the proper metals could not be obtained cheaply enough until a few years ago. Indeed, some of them were mere laboratory rarities when he commenced his epoch-making researches. Before he began, he studied everything that had been done before him, so that he could take up the work where his predecessors had ceased. When he finally decided that the filament must be made of carbon, he began a search for the proper raw material which may well be considered a quest for a scientific Holy Grail. Men were dispatched to all quarters of the globe to search for fibers having the requisite properties. One of these scientific crusaders ransacked the Amazon jungles and tasted no meat for a hundred and sixteen days. The eighty varieties of bamboo and three thousand specimens of fibers brought back by these emissaries were tested in Edison's laboratory, and all but three or four rejected. Night after night he and his assistants slept in the laboratory with resistance-boxes for pillows and work benches and tables for beds. Food was passed in to them through the windows. Doggedness such as this was bound to bring success.

The same story could be told of every one of the hundreds of inventions that Edison has patented. The method of procedure (an object lesson to every inventor) is always the same. He invariably begins his investigations by a thorough course of reading, fully conscious that he is not the first in the field and that he must know where others failed. After a thorough review of the subject he begins actual work—an expert, who carefully avoids covering ground which has already been explored and who begins where others abandoned investigation. Experiments are made by the hundred and thousand. Model after model is built. Failure succeeds failure, until further efforts seem hopeless. For all that more experiments are made, and more models built. At last an experiment is conducted or a model constructed that seems faintly encouraging. A less experienced inventor would be elated. Edison, however, regards the favorable result with suspicion. Not until the partial success has been confirmed by many repetitions of the experiment is he convinced that something has been achieved.

THE MONEY VALUE OF EDISON'S INVENTIONS.*

The activities of Mr. Edison have been of such great range, and his conquests in the domains of practical arts so extensive and varied, that it is somewhat difficult to estimate with any satisfactory degree of accuracy the money value of his inventions to the world.

First of all, let us mention the incandescent electric light and systems of distribution of electric light, heat, and power, which may justly be considered as the crowning inventions of Mr. Edison's life. To-day there are in the United States more than 41,000,000 of these lamps, connected to existing central station circuits, in active operation. At the present time there are over 5,000 central stations in this country for the distribution of electric current for light, heat, and power, with capital obligations amounting to not less than $1,000,000,000. Besides the above-named 41,000,000 incandescent lamps connected to their mains, there are about 500,000 arc lamps and 150,000 motors, using 750,000 horse-power, besides countless fan motors and heating and cooking appliances. The gross earnings of these central stations approximate the sum of $225,000,000 yearly.

In addition to central stations there are upward of 100,000 isolated or private plants in mills, factories, steamships, hotels, theaters, etc., owned by the persons or concerns who operate them. These plants represent an approximate investment of $500,000,000, and the connection of not less than 25,000,000 incandescent lamps, or their equivalent.

Then there are the factories where these incandescent lamps are made, about forty in number, representing a total investment that may be approximated at $25,000,000.

The reader will naturally be disposed to ask whether it is intended to claim that Mr. Edison has brought about all this magnificent and wonderful growth of the electric lighting art. The answer to this is decidedly in the negative, for the fact is that he laid the foundation and erected a building thereon, and in the natural progressive order of things other inventors of more or less fame have added a wing here and a story there until the resultant great structure has attained such magnificent proportions as to evoke the wonder and amazement of the beholder; but the old foundation and the fundamental building still remain to support the other parts.

Edison was the first man to devise, construct, and operate from a central station a practicable, life-size electric railroad, which was capable of transporting and did transport passengers and freight at variable speeds over varying grades, and under complete control of the operator. While Mr. Edison's original broad ideas are embodied in present practice, the perfection of the modern electric railway is also greatly due to the labors and inventions of a large number of other well-known inventors.

The statistics of 1908 for American street and elevated railways show that within twenty-five years the electric railway industry has grown to embrace 38,812 miles of track on streets and for elevated railways, operated under the ownership of 1,238 separate companies, whose total capitalization amounts to the enormous sum of $4,123,834,598 in 1908. In the equipments owned by such companies there are included 68,636 electric cars and 17,568 trailers and others, making a total of 86,204 of such vehicles. These cars and equipments earned over $425,000,000 in 1907, in giving the public transportation, at a cost, including transfers, of a little over 3 cents per passenger, for whom a 15-mile ride would be possible. No cheaper transportation is given in the world.

Some mention should also be made of the great electrical works of the country, in which the dynamos, motors, and other varied paraphernalia are made for electric lighting, electric railway and other purposes. The productions of the General Electric Company alone, as shown by average annual sales of over $50,000,000, are of themselves a colossal item, but they do not comprise the total of the country's manufactures in these lines, which amount to five times as much again.

To Alexander Graham Bell is due the broad idea of transmission of speech by means of an electrical circuit. Mr. Edison invented and brought out the carbon transmitter, which is universally acknowledged to have been the needed device that made the telephone a commercial possibility, and has since led to its phenomenally rapid adoption and world-wide use. His inventions may be found in every one of the 7,000,000 telephones employed in the country at the present day. On a conservative estimate at this writing the investment has been not less than $800,000,000 in now existing telephone systems, and no fewer than 10,500,000,000 talks over the lines during the year 1908. These figures relate only to telephone systems, and do not include any details regarding the great manufacturing establishments engaged in the construction of telephone apparatus, of which there is an annual production amounting to at least $15,000,000 per annum.

There is no way in which any definite computation can be made of the value of Mr. Edison's contributions in the art of telegraphy except, perhaps, in the case of his quadruplex telegraph, through which alone it is estimated that there has been saved from $15,000,000 to $20,000,000 in the cost of line construction in this country.

At Orange, N. J., may be found the National Phonograph Company, the Edison Business Phonograph Company, the Edison Phonograph Works, the Edison Manufacturing Company, the Edison Storage Battery Company, and the Bates Manufacturing Company. The importance of these industries will be apparent when it is stated that there are upward of 3,600 people employed, and an annual payroll of about $2,250,000.

There have been upward of 1,310,000 phonographs sold during the last twenty years, with and for which there have been made and sold no less than 97,845,000 records of a musical or other character. Phonographic records are now being manufactured at Orange at the rate of 75,000 a day, the annual sale of phonographs and records being approximately $7,000,000, including business phonographs. The figures given represent only about one-half of the entire business of the country in phonographs, records, cylinders, and supplies.

Taking next his inventions that pertain to "moving pictures," we find that from the inception of the moving-picture business to the present time Edison has made upward of 13,100 projecting machines and many million feet of film carrying small photographs of moving objects. Although the moving-picture business is still in its youth, it calls for the annual production of thousands of machines and many million feet of films in Mr. Edison's shops, having a sale value of not less than $750,000. The annual product of the Edison Manufacturing Company in this line is only a fractional part of the total that is absorbed by the 10,000 or so moving-picture theaters and exhibitions which are in operation in the United States at the present time, and which represent an investment of some $40,000,000. Licensees under Edison patents in this country alone produce upward of 60,000,000 feet of films, containing more than a billion and a half separate photographs.

In making a somewhat radical change of subject, from moving pictures to cement, we find ourselves in a field in which Mr. Edison has made a most decided impression. His corporation in five years has grown to be the fourth largest producer in the United States, with a still increasing capacity. His plant, which occupies 40 acres, represents an approximate investment of $4,000,000 in quarries, railroads, and machinery. The production reaches a grand total of over 5,000,000 barrels of cement up to the present date, having a value of about $4,500,000, exclusive of package. At the time of this writing, the rate of production is over 8,000 barrels of cement per day, or say 2,500,000 barrels per year, having an approximate selling value of a little less than $2,000,000, with prospects of increasing in the near future to a daily output of 10,000 barrels.

Condensing the information above given, we have the following table of Mr. Edison's industrial activity:

STATISTICAL RESUME (APPROXIMATE) OF SOME OF THE INDUSTRIES IN THE UNITED STATES DIRECTLY FOUNDED UPON OR AFFECTED BY INVENTIONS OF THOMAS A. EDISON.

Class of Industry.	Investment.	Annual Gross Revenue or Sales.	Number of Employees.	Annual Pay Rolls.
Central station lighting and power	$1,000,000,000	$225,000,000	50,000	$40,000,000
Isolated incandescent lighting	500,000,000	——	33,000	17,000,000
Incandescent lamps	25,000,000	20,000,000	14,000	6,000,000
Electric fixtures	8,000,000	5,000,000	6,000	3,750,000
Dynamos and motors	60,000,000	50,000,000	20,000	20,000,000
Electric railways	4,000,000,000	430,000,000	250,000	155,000,000
Telephone systems	800,000,000	175,000,000	140,000	75,000,000
Telephone apparatus	30,000,000	15,000,000	12,000	5,500,000
Phonograph and moving pictures	10,000,000	15,000,000	5,000	6,000,000
Moving picture theaters	40,000,000	80,000,000	75,000	37,000,000
Edison Portland cement	4,000,000	2,000,000	500	400,000
Telegraphy	$250,000,000	60,000,000	100,000	30,000,000

On the 110,000-volt transmission line running from Grand Rapids to Croton Dam, Mich., triangular steel towers are used, which are placed 528 feet apart. In place of the usual pin insulators, for attaching the wires to the cross arms, a special form of disk insulator is used, consisting of a series of five separate disks of insulating material, which are strung together and suspended from the end of the cross arm. These disks are 10 inches in diameter, and each one is rated to stand 25,000 volts. This system of insulation has proved entirely satisfactory.

* Abstracted from the forthcoming "Life of Edison," by Frank L. Dyer and T. Commerford Martin. Copyright, 1908, by Harper & Bros.

MOTORING ON RUNNERS.

An interesting new field for experiment by the ingenious amateur seems to be opened by the application of mechanical power to bob-sleds or sleighs. The automobile for ordinary roads has practically reached a stage of development at which no new problems are likely to be encountered. Many difficulties have been overcome, and those remaining are so well understood that their ultimate elimination is unlikely to be achieved, except by development and perfection of present methods.

Entirely new problems arise, however, in an unexpected manner where an attempt is made to produce corresponding speed from the same power by the mounting of engines upon runners for use on ice or snow.

The advantages of runners over wheels, especially for travel in snow, are the same for automobiles as for horse-propelled vehicles, the long bearing surface preventing the drops into comparatively small irregularities of the road, to which wheels are liable. Every automobile driver knows the great loss of speed which follows the drop of his wheels into any considerable hole, quite apart from the discomfort and danger of breakage due to jar, and the consequent necessity of slow travel on rough roads. Automobile wheels being generally much smaller than those of older road vehicles, their substitution by sleigh runners should give greater proportionate speed possibilities, and the high speeds attained with small power by some of the machines here illustrated seems to support this theory.

The most obvious difficulty of design is that of applying engine power to propulsion when rotatable wheels bearing the weight are removed. As will be seen from our illustration, a number of attempts to overcome this have been made, varying from reciprocating pushers to retention of automobile wheels carrying no weight and applicable to the snow surface as required.

A less obvious difficulty is the tendency of iron or steel runners to adhere to snow or ice, causing much more power in proportion to be required for starting a sleigh than for starting a wheeled vehicle.

The center of motor-sled activity in this country seems to be Huntington, Long Island, or rather Halesite on Huntington Harbor. If there has been as much emulation in other parts of the country, news of it has failed to reach the Scientific American. Halesite produced no less than three rival motor-sleds, and of these the most elaborate, of which the fullest particulars are obtainable, is that built by the Atkin-Wheeler Company.

This professedly experimental craft was intended principally to accumulate data for improved design, and for that purpose seems to have been successful. The three-runner type of suspension common to most ice yachts was adopted, engine and driving mechanism being carried between two parallel runners forward, and a rear central runner pivoted at its forward end, operating exactly like a rudder. The sled is driven by means of a spiked wheel, the teeth of which engage the snow. The entire motive mechanism is sustained upon a frame separate from the chassis and hinged at the forward end. The after end of the motor frame contains the drive wheel, an 18-inch pressed-steel wheel shod with peculiarly designed snow spikes. At first casehardened steel spikes were used, but it was soon perceived that the adhesiveness between the steel and snow quickly clogged the spaces between the spikes; this was overcome by using spikes made from a special bronze alloy.

The entire frame and chassis is constructed of California redwood, reinforced throughout with steel gussets. Under the forward part of the chassis, between the forward runners, crossed steel buckle-rods are used, to prevent spreading of the runners when negotiating sharp turns.

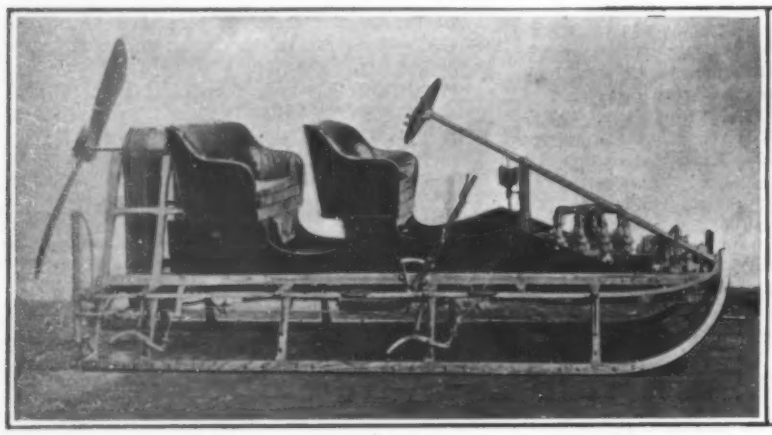
Double chain drive was first used, the after end of the motor frame being elevated sufficiently to allow the drive wheel to clear the ground, upon starting up the motor, and then lowered as headway was gained. On account of the apparent "sticking" of the steel runners, when the sled rested on one spot for more than a minute, the power required to overcome the accentuated inertia caused stripping of the driver spikes. As the space between the motor and drive shaft was too limited to allow the use of a clutch, a shifting belt drive was resorted to, which proved successful. Upon slowly throwing in the belt on to full load, and the inertia being overcome, a start was made with extreme rapidity.

A second quite elaborate machine, of which fewer particulars are available, was driven in a similar manner, but the builder had made no allowance for overload in starting, and stripped the teeth of his gears. He is now introducing a change-speed gear, such as is used on wheeled automobiles, and given favorable weather will make further trials later.

As sometimes happens, however, the apparatus simplest in construction gave the best results in practice. This was the "Freak" of Messrs. Diefendorf and Robbin, built at a total cost, so the owners claim, of eighty cents. This, of course, does not include the engine, shafting, and wheels, which were "borrowed" from an automobile, nor the lumber, which the builders had. Two sleds from an old "bob" were used, connected by two long pieces of 2-inch by 6-inch plank, placed 18 inches apart. The engine was placed over the rear sled with the jackshaft slightly forward, a friction wheel on the flywheel allowing two speeds ahead and one reverse. The jackshaft drove by chain and sprockets an ordinary automobile rear axle and wheels, the axle being so mounted as to be raised and lowered at will. It lifts the wheels clear of the snow, when coasting, and is pressed down by means of a foot lever when driving. The builders consider this the best form of drive for snow that has appeared, the automobile tires adjusting themselves to irregularities in the surface, and keeping their chains engaging the snow as uniformly as possible. They have, however, plans for an improved drive wheel for use next season. The forward sled is pivoted, and carries an automobile steering gear, handled by one man, while another tends the gear lever. The "Freak" was the only machine to appear in a competition arranged for the three motor sleds. It traveled at the rate of 30 miles an hour on open road, negotiating steep hills with ease, and covered a measured three-quarters of a mile in 37 seconds on a prepared track.

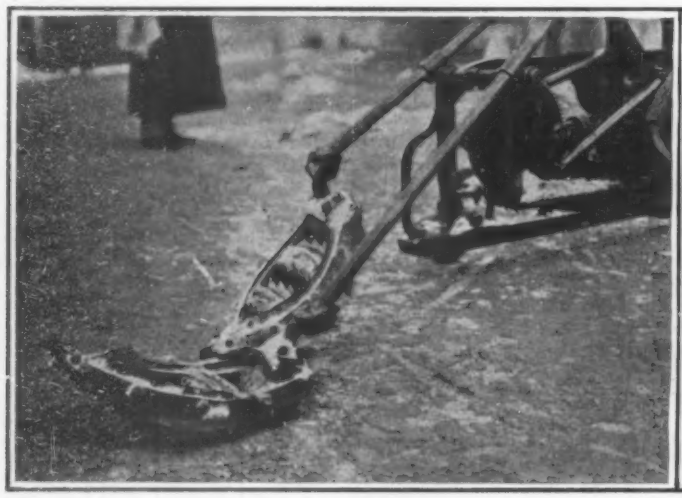
One of the most successful of foreign automobile sleighs is that most similar in principle to the "Freak," namely, the "Labesse," illustrated herewith, which is, however, a more elaborately constructed vehicle. The application of power to propulsion is also made by means of wheels, and, as in the "Freak," the latter are adjustably mounted. By means of the vertical screw visible at the driver's right, and a corresponding screw attached to it by gear and chain on the other side of the sleigh, the bottom member of the frame supporting the wheels, which is hinged to the upper part of the frame at its rear end, may be raised or lowered as desired, maintaining engagement of the wheel teeth with the snow or lifting them clear of it in coasting. The front runners are independently mounted, exactly as automobile wheels are, and are steered by a similar gear.

The "Peroche" automobile sleigh is the invention of a Russian machinist, its distinguishing features



The Austrian Wels motor-sleigh.

The Labesse motor-sleigh.



The Peroche pushing mechanism.

The Peroche auto sleigh.

being propulsion by means of reciprocating pushers. The success of this machine seems to have been very largely due to the design of the latter. It will be noticed from the near view showing the pushers that they are armed with backward-pointing saw teeth, sliding easily when withdrawn, and that the shape and suspension of the shoe are such that it maintains its engagement with the ice or snow from beginning to end of the stroke, in spite of the necessary rise and fall of the outward end of the operating rod. The steering is managed by an ingenious gearing, which slides the cranks operating the pusher rods through their attachment to the connecting rods, thereby shortening or lengthening the stroke of the pushers on one side or the other. The "Peroche" is apparently intended to negotiate a greater variety of surfaces than the afore-mentioned vehicles, being provided with small wheels which are not adjustable to carry it over surfaces barren of snow, and its runners being much broader than those of the others, to support it in softer or less compact snow.

The driving method most suggestive of speed, or at least ambition for it, is that of the "Wels," an Austrian motor sled, the sole means of propulsion of which is a screw propeller like that of an airship. Whereas this method of propulsion has been successfully applied to hydroplane and other boats, it would seem from the experience of the Long Island experimenters that the resistance to starting of a heavy sleigh on metal runners adhering to ice or snow would be disproportionately greater than the skin friction of a boat, and that air resistance would be hardly sufficient to start this type of sleigh with long, continuous runners. Once started, the "Wels" sleigh has great possibilities for speed. It is steered by means of rearward extensions of both runners, vertically pivoted at their forward end, and operated exactly like rudders by means of wires from the automobile steering gear.

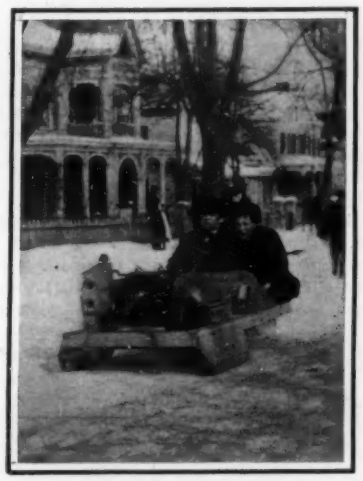
It will be seen that from its driving mechanisms alone automobile sleighing offers more variety than road automobiling, not to mention the other interesting problems above alluded to. Whereas the sleighing season is so short as to be almost non-existent locally, the field for such machines is much greater in Canada and other countries where winter sports have a longer annual life, and a successful motor sled would find a ready market. Considering the low cost at which the motor sled may be built as compared with the road automobile, its development offers an attractive and possibly lucrative occupation for the snow-bound chauffeur or amateur mechanic.

Prof. Osborn's Reminiscences of Darwin.

In commemoration of the centenary of Darwin's birth, Prof. Henry Fairfield Osborn, who besides being president of the Museum of Natural History is professor of zoology in Columbia, gave some reminiscences of Darwin before an audience at the American Museum of Natural History.

"On December 8, 1879," said he, "when Darwin was in his seventieth year and I in my twenty-second, I had the rare privilege of meeting him and looking steadily in his face during a few moments' conversation. It was in Huxley's laboratory, and I was at the time working upon the anatomy of the crustacea. The entry in my journal is as follows:

"'This is a red letter day for me. As I was leaning over my lobster (*Homarus vulgaris*) this morning, cutting away at the brain, I raised my head and looked up to see Huxley and Darwin passing by me. I believe I never shall see two such great naturalists together again. I went on apparently with skill, really hacking my brain away, and cast an occasional glance at the great old gray-haired man, and was startled, so unexpected was it, by Huxley speaking to me and introducing me to Darwin as an American who had already done some good paleontological work on the other side of the water. I gave Darwin's hand a tremendous squeeze (for I never shall shake it again) and said without intending in an almost reverential tone: "I am very glad to meet you."



The A-W motor sled.

"'He stands much taller than Huxley; has a very ruddy face, with benevolent blue eyes and overhanging eyebrows. His beard is quite long and perfectly white, and his hair falls partly over a low forehead. His features are not good. My general impression of his face is very pleasant. He smiled broadly, said something about a hope that Marsh, with his students, would not be hindered in his work, and Huxley, saying "I must not let you talk too much," hurried him on into the next room.'

"Another memory of interest is that the instant Huxley closed the door I was mobbed as the 'lucky American' by the ninety less fortunate students of Great Britain and other countries."

The Langley Medal Awarded to the Wrights.

The first award of the gold medal recently established by the Smithsonian Institution in memory of the late secretary Samuel Pierpont Langley and his contributions to the science of aerodromics is made to Wilbur and Orville Wright.

The Langley medal was founded "to be awarded for specially meritorious investigations in connection with the science of aerodromics and its application to aviation." The original design to be used for this medal was made by Mons. J. C. Chaplain, of Paris, a member of the French Academy. The medal bears on its obverse a female figure, seated on the globe, carrying a torch in her left hand and in her right a scroll emblematic of knowledge and the words "*Per Orbem.*" The reverse is adapted from the seal of the institution as designed by Augustus St. Gaudens, the special inscription being inserted in the center instead of the map of the world. It is about three inches in diameter.

A $500 Prize for a Simple Explanation of the Fourth Dimension.

A friend of the SCIENTIFIC AMERICAN, who desires to remain unknown, has paid into the hands of the publishers the sum of $500, which is to be awarded as a prize for the best popular explanation of the Fourth Dimension, the object being to set forth in an essay the meaning of the term so that the ordinary lay reader can understand it.

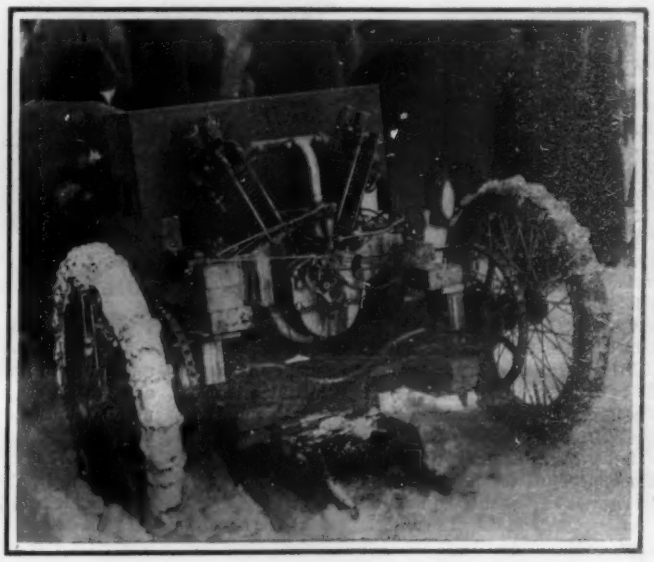
Competitors for the prize must comply with the following conditions:

1. No essay must be longer than 2,500 words.
2. The essays must be written as simply, lucidly, and non-technically as possible.
3. Each essay must be typewritten and identified with a pseudonym. The essay must be inclosed in a plain sealed envelope, bearing only the pseudonym. With the essay should be sent a second plain sealed envelope, also labeled with the pseudonym, and containing the name and address of the competitor. Both these envelopes should be sent to "Fourth Dimension Editor, SCIENTIFIC AMERICAN, 361 Broadway, New York, N. Y."
4. All essays must be in the office of the SCIENTIFIC AMERICAN by April 1, 1909.
5. The Editor of the SCIENTIFIC AMERICAN will retain the small sealed envelope containing the address of the competitor and forward the essays to the Judges, who will select the prize-winning essay.
6. As soon as the Judges have agreed upon the winning essay, they will notify the Editor, who will open the envelope bearing the proper pseudonym and containing the competitor's true name. The competitor will be notified by the Editor that he has won the prize, and his essay will be published in the SCIENTIFIC AMERICAN.
7. The Editor reserves the right to publish in the columns of the SCIENTIFIC AMERICAN or the SCIENTIFIC AMERICAN SUPPLEMENT three or four of the more meritorious essays, which in the opinion of the judges are worthy of honorable mention.

Prof. Henry B. Manning, of Brown University, and Prof. S. A. Mitchell, of Columbia University, will be the judges.

The question of equipping automobiles at present with incandescent electric headlights having tungsten filaments is worth attention. Miniature lamps of any size or shape for any general use are available, and have been for a number of years. To operate these lamps on an automobile means a source of current on the machine. With an electric power vehicle this is easily obtained from the power storage battery; in the gasoline automobile, electricity is not available except for ignition purposes. This is either furnished by a magneto or by a storage battery, or by a combination of storage batteries and a dynamo. Therefore, to use electric lamps on a gas automobile a storage battery of a capacity sufficient to serve ignition purposes and also furnish lighting current is needed. Within the past year the development of the tungsten incandescent lamp has made everyone interested in electric light. The tungsten lamp uses only one-third as much electricity as the common carbon filament incandescent lamps, which have been in use for a dozen years or more. This saving in current suggests the idea of equipping gasoline automobiles with tungsten incandescent lamps, which can be supplied from a storage battery carried for this purpose only, or from the battery used for the purpose of ignition, as this battery must be carried anyway.

The American "Freak" motor-bob.



Engine and driving arrangement of the "Freak."

MOTORING ON RUNNERS

THE HEAVENS IN MARCH.

BY HENRY NORRIS RUSSELL, PH.D.

THE planet Jupiter is now just past opposition, and is visible all night long—the chief ornament of the sky. While the amateur astronomer, with a small telescope, may find delight in watching its markings, changing hour by hour before his eyes as the planet rotates, and the varying aspects of its four large satellites, the most powerful instruments of some of the world's greatest observatories will be busy photographing its faint outer satellites, which can be observed only in this way.

The faintest and most distant of these—discovered last year at Greenwich—has been found again, on photographs taken at the same place on January 16th very near the place predicted by the calculations of Cowell and Crommelin, of which we spoke some months ago.

These new satellites of Jupiter, so much like the asteroids, and so distant from their primary, naturally make us ask: Have they really always belonged to Jupiter's system, or are they stray asteroids, which, having at some past time passed near the planet, have been "captured" by its attraction, and left revolving around it?

To see how this problem can be attacked, let us imagine first that we are dealing with a projectile shot upward from the surface of Jupiter at a fixed velocity. If this is small—say that of a cannon ball—it will rise only a few miles, and then fall back upon the planet. As the initial velocity is increased, the height to which it will rise, before Jupiter's attraction puts an end to its ascent, will increase.

If nothing but the planet's attraction came into play, this height would be the same, from whatever part of the planet's surface the shot was fired (neglecting certain small effects due to the elliptical form of the planet). That is, the projectile can never get beyond a certain distance from the planet's center. Wherever it starts, and wherever it goes, it must always be inside a sphere whose center is the planet. The size of this sphere depends on the initial velocity alone.

If now we take into account the fact that the sun, as well as Jupiter, attracts the projectile, we find, after calculation, that the region to which it is confined is no longer spherical, but egg-shaped, with its long end pointing toward the sun. As before, the height above the planet's surface to which it may rise is limited; but in the direction of the sun it is greater than in the opposite direction.

If the initial velocity of the projectile is increased, this egg-shaped region grows bigger in all directions, but especially toward the sun.

As we still increase the velocity, we reach a point at which the projectile, if aimed in the right direction, will pass beyond the "neutral point" where the influence of the attraction of Jupiter balances that of the sun, and escape from the planet's influence, for a time at least. For velocities greater than this, the egg-shaped region must be replaced by one resembling an hour-glass with two unequal bulbs, the small one surrounding Jupiter, and the big one the sun.

Now, in order to calculate the size and shape of this limiting region, we need not assume (as we did above for the sake of clearness) that our moving body started from the surface of Jupiter. We may start it anywhere in the planet's vicinity; and if we know its distances from Jupiter and from the sun, and the direction and speed of its motion, we can determine the shape of the limiting region.

If this is egg shaped, and surrounds Jupiter alone, the body, however the sun's attraction may change the shape of its orbit, can never leave the planet altogether, but must always remain, and, reckoning backward, always has been, a satellite.

But if it includes both the sun and planet, it is then possible that the small body's orbit about Jupiter may be so changed that at some future time it will pass through the neck of the hour glass, and recede very far from the planet; and of course the reverse process may have occurred in the past.

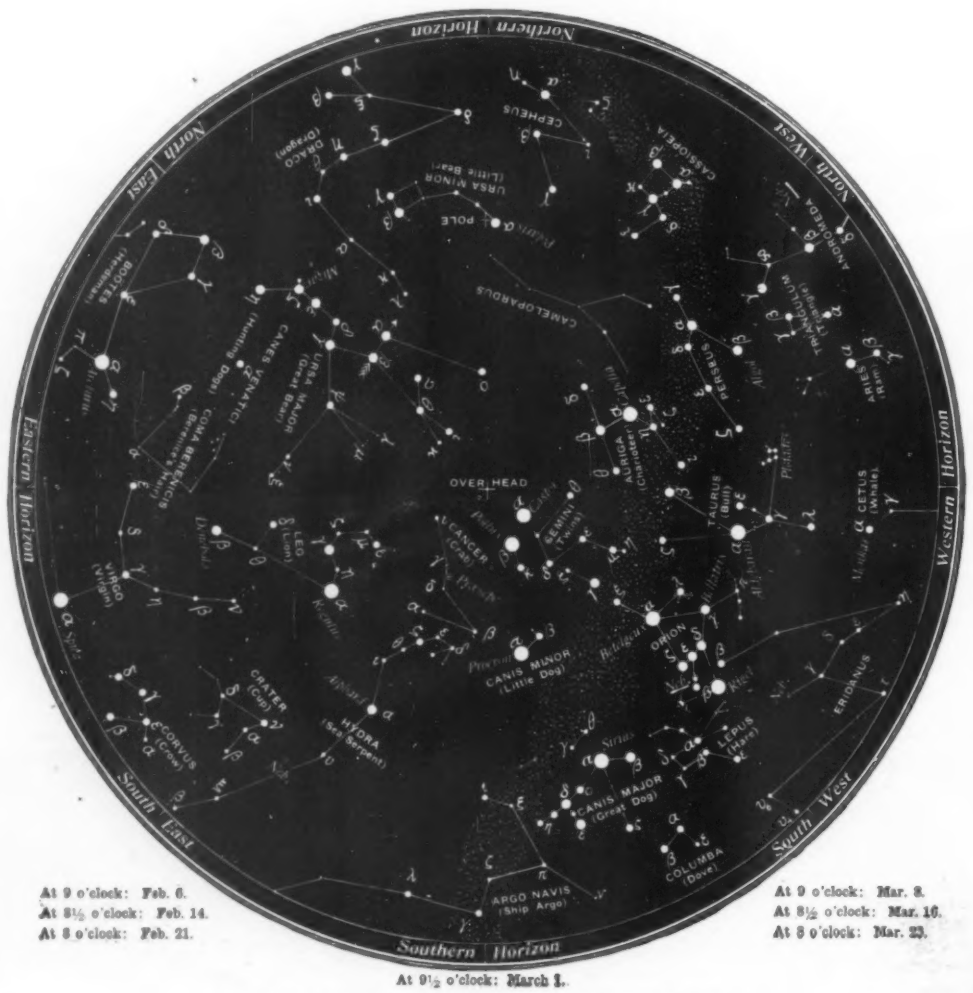
When the actual computations are made, it is found that the sixth and seventh satellites of Jupiter, as well as all those of the other planets, are of the first sort. They always have been near their primaries, and always will be. But the eighth satellite is an example—and the only known one—of the other case. It may be a captured asteroid, and may at some future time rejoin its former fellows; but at present it is impossible to say whether it has ever actually done so, or ever will.

THE HEAVENS.

The winter constellations are now well past the meridian. Taurus is almost due west, Orion about southwest, and Canis Major west of south. On the other side of the Milky Way, and higher up, are Canis Minor and Gemini. The latter constellation—which is figured in our initial letter—bears some faint resemblance to its prototype, and what is more remarkable, to its conventional sign, which consists of two parallel lines joined at top and bottom. The bright stars Castor and Pollux are in the heads of the figures whose name they bear. No other two bright stars visible in our latitude are nearly as close together, and they cannot be mistaken when once seen. Castor is a fine double, easily seen with a small telescope. The faint star near by is moving with the other two, which revolve about one another in a period of some 350 years.

Auriga is northwest of the zenith, with Perseus below. Cassiopeia and Cepheus are below the pole on the left, and Ursa Minor and Draco on the right.

Ursa Major is high up in the northeast, splendidly displayed. The curve of its tail (the Dipper handle) followed downward points out Arcturus, which has just risen south of east, and still lower in Spica, in the constellation Virgo. Above this is Leo, with Jupiter far outshining any of his stars. Cancer, almost overhead, is worth looking at only for the star cluster Praesepe (interesting in an opera glass). Hydra in the southeast has but one solitary bright star, Alphard; but its long line descending from near Procyon to the horizon is fairly conspicuous. Argo, low in the south, is one of the finest constellations in the heavens; but we never see its brighest stars at all, nor the rest of it well.



At 9 o'clock: Feb. 6.
At 8½ o'clock: Feb. 14.
At 8 o'clock: Feb. 21.

At 9 o'clock: Mar. 8.
At 8½ o'clock: Mar. 16.
At 8 o'clock: Mar. 23.

At 9½ o'clock: March 1.

NIGHT SKY: FEBRUARY AND MARCH

THE PLANETS.

Mercury is morning star, best visible about the 9th, when he is at his greatest apparent distance from the sun; but he is far south, and rises only about 5:20 A. M., so he is not favorably placed.

Venus is morning star, still nearer the sun than Mercury, and can hardly be seen at all, except just before sunrise at the beginning of the month.

Mars is morning star in Sagittarius, rising about 3 A. M. He is still too far away to look very bright, being four times as remote from us as he will be in September.

Jupiter is in Leo, just past opposition, and observable till near daybreak. His satellites can be seen with a field glass, and even a small telescope will show much detail on his disk. The full list of the transits and eclipses of the satellites is too long to give here, but it may be mentioned that, about midnight on the 5th, both the first and third satellites, and their shadows, will be projected upon the planet's disk.

Saturn is evening star in Pisces, setting about 8 P. M. on the 1st, but becomes lost in the twilight before March is over.

Uranus is morning star in Sagittarius. On the mornings of the 26th and 27th he will be very near Mars—to the left on the first date, and above on the second, as seen in the morning sky—and so he can be easily identified.

Neptune is in Gemini, observable all the evening.

THE MOON.

Full moon occurs at 10 P. M. on the 6th, last quarter at 11 P. M. on the 14th, new moon at 3 P. M. on the 21st, and first quarter at noon on the 28th.

The moon is nearest us on the 21st, and farthest off on the 7th. She is in conjunction with Neptune on the 1st, Jupiter on the 6th, Mars and Uranus on the 16th, Mercury on the 19th, Venus on the 20th, Saturn on the 22d, and Neptune again on the 29th.

At 1 A. M. on the 21st the sun crosses the equator, passing through the point in the heavens known as the vernal equinox, and, in almanac language, "spring commences."

Princeton University.

To Keep Eggs.

Eggs are often preserved by packing them in chopped straw, salt ashes, slaked lime, or other dry material, by immersing them in lime water, solution of water glass (sodium silicate) or of salicylic acid, or by coating them with air-excluding substances or germicides. Eggs packed dry are apt to become musty and acquire an unpleasant flavor. It is better to immerse them in lime water, water glass, or salicylic acid, or to varnish them. A very good liquid for immersion is made by dissolving salicylic acid to saturation in a mixture of 1 part glycerin, 5 parts strong alcohol, and 15 parts water. The eggs should not be more than 10 days old when immersed. They should be carefully cleaned and all spotted or addled eggs should be excluded.

The average automobile user is the prospective purchaser of some better machine than the one he may be using at the present time. Invariably the owner of an automobile who purchases a new car pays more money for it than for his first purchase. In the automobile business, quality is almost invariably commensurate with price. The car which is built under a full year guaranty costs more as a rule than the car which is built under one covering a period of sixty to ninety days. For example, a car which is guaranteed for a full year must be built of such materials and with such care and must incorporate such mechanical principles as will enable its makers to guarantee the car free of cost for repairs due to defective material or workmanship for that time.

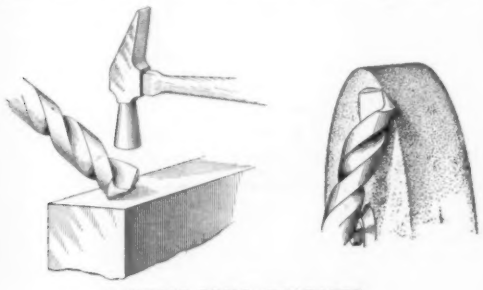
Handy Man's Workshop

The Editor of Handy Man's Workshop will be glad to receive any hints for this department and pay for them if available.

SIMPLE DRILL CLEARANCE.

BY ALBERT F. BISHOP.

When the drill pinches and squeals on drilling through pieces of wrought iron and copper, and is liable to



A SIMPLE DRILL CLEARANCE.

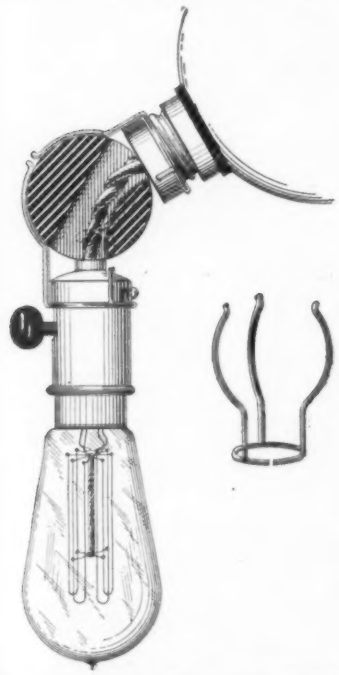
twist off before you get the job done, why don't you swedge it? Use a small hammer, and be careful not to chip the corner, as the drill is swedged cold. Just touch the fluted part lightly on the emery wheel, bringing back a nice cutting edge and leaving the swedged corner projecting a little. The writer has used this little wrinkle for a number of years, and masters those stubborn pieces with ease.

HOME-MADE ADJUSTABLE SOCKET FOR TUNGSTEN LAMPS.

BY JOHN A. BERGSTROM.

The accompanying illustration shows a very simple way of making an adjustable socket for tungsten lamps, in which the lamp will tend to hang perpendicularly of its own weight. A cage is first made consisting of three or more prongs, brazed to a split ring, which is slipped over the lamp socket. A similar cage is made to slip over the neck of the plug. The prongs may also be soldered to the socket and the plug. These prongs must be long enough to extend past the center of a solid rubber ball, which is to unite the lamp socket and plug. The rubber ball may be purchased at any toy store.

With a thin metal tube cut a hole through the center



ADJUSTABLE SOCKET FOR TUNGSTEN LAMPS.

of the ball. This is easily accomplished by turning the metal tube with one hand and holding the ball with the other. By running the tube through the rubber a second time at an angle to the first hole an oblong bore is made, such as shown in the illustration. Through this hole put an ordinary lamp-cord and connect one end with the plug and the other with the lamp socket. Now screw the plug into the bracket and turn the ball so that the lamp socket hangs perpendicularly. Then screw in the lamp. It will be seen that almost any angle may be obtained.

FURNISHING THE WORKSHOP.—III.

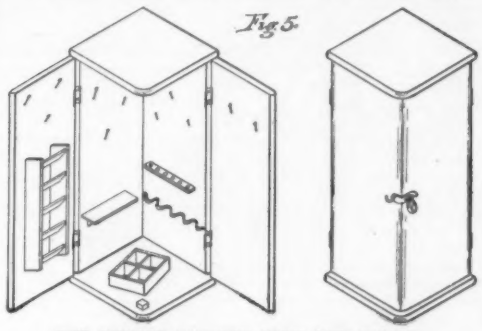
BY I. G. BAYLEY.

(Continued from the issue of February 6th.)

A CORNER CABINET.

The large heavy tool chests which were at one time so much in use are very awkward to get at, injurious

Fig. 5.



THE CORNER CABINET OPEN AND CLOSED.

to the tools, and in other ways inconvenient and out of date. A cabinet secured to the wall, within easy reach, is more convenient, and each tool can be seen at a glance, having its appointed place, hung either vertically or horizontally on a peg or shelf or in a drawer within the cabinet. A tool cabinet is cheaper, and is made more easily than a chest. By referring to any tool catalogue, it will be seen that it is simply a flat oblong box with a recessed lid. The latter can be made from a box procured at a hardware store or box factory at little expense. But to have something different is generally the desire of most boys.

The corner cabinet, or cupboard, shown in Fig. 5, and detailed in Fig. 6, is not only original, but more easily made than any of the foregoing tool chests or cabinets.

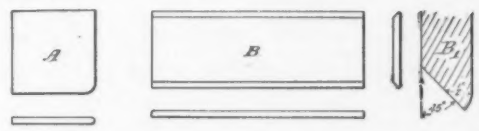
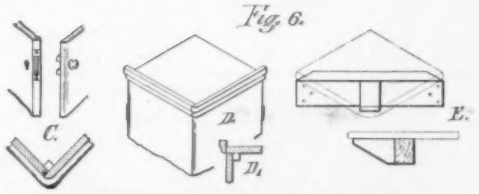


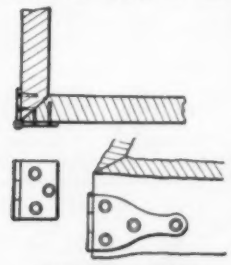
Fig. 6.



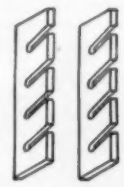
CONSTRUCTIONAL DETAILS OF THE CABINET.

The top and bottom are made from two boards, 13 inches square by 1 inch thick. The projecting corner is rounded off to a radius of 1½ inches, and the adjacent sides have their edges slightly rounded, as shown at *A* in Fig. 6. Four sides, *B*, are cut from 1-inch boards, 2 feet 9 inches in length and 12 inches wide. The edges are chamfered at an angle of 45 degrees, and the corners rounded off to a radius of ½ inch, as detailed at B_1. Two of the sides, *B*, are secured together with nails and glue, and the top and bottom nailed in position, flush with the outside edges, which are square, allowing the cabinet to fit close against the corner of the shop. The other two edges, which are rounded off to give a neat finish, project 1 inch, as clearly seen in Fig. 5.

Either a padlock, with strap, can be used to lock the cabinet, or a flush lock, as shown at *C* in Fig. 6. Two blocks of wood, for the doors to bear against



HOW THE HINGES ARE APPLIED.



RACK FOR CHISELS.

when closed, are secured to the bottom and underside of the top, 2 inches from the edges. These are shown in Fig. 5, and at *C* and D_1 in Fig. 6. If desired, the top and bottom can be made 12 inches square, and finished off with a cornice, as shown at *D* and D_1.

The cabinet can be supported on a bracket, made from a piece of 3 x 4-inch timber, as detailed at *E*. Spikes driven into the wall, through the sides of the cabinet, will further secure it.

Two hinges should be on each door, either made flush, as shown in the general view, Fig. 5, or on the outside, as shown in the accompanying detail view.

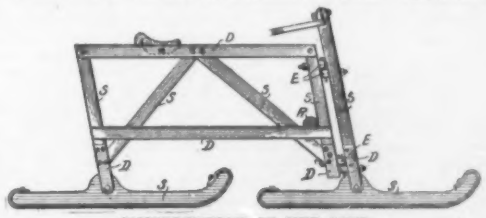
The furnishing of the cabinet is a matter of choice, and depends to a certain extent on how many tools are placed in it. The saws and lighter tools should be hung upon the doors, the heavier tools inside. Shelves and racks of wood or leather, for the bits and handle tools, can be easily made. A rack constructed as shown, hung upon the door, will be found very useful for small tools. Chisels, etc., can be supported on vertical strips of board, notched as shown in adjoining sketch. Either a plain oil finish or the natural wood is all the cabinet requires when complete.

(To be continued.)

BICYCLE COASTING SLED.

BY E. E. CLOCK.

The accompanying drawing and photograph illustrate a new type of coasting sled built on the bicycle principle. This coaster is simple and easy to make. It is constructed of a good quality of pine. The pieces



CONSTRUCTION OF THE SLED.

marked *S* are single, and should be about 1 x 1½ inches; the pieces marked *D* are double or in duplicate, and should be about ½ x 1½ inches. The runners are shod with iron and are pivoted to the uprights as shown, double pieces being secured to the uprights to make a fork. The seat is a board, to the

BICYCLE TYPE OF SLED.

underside of which is a block, which drops down between the two top slats and is secured with a pin. A footrest, *R*, is provided consisting of a short crosspiece secured to the front of frame and resting on the two lower slats. The frame and front fork are hinged together with four short eyebolts, *E*, with a short bolt through each pair as shown.

HOW TO DRILL THROUGH BRICK AND SOFT STONE.

BY B. A. JOHNS.

The accompanying illustration represents a very good drill for brick walls and soft stone. The drill is

DRILL FOR BRICK WALLS AND SOFT STONE.

made of an ordinary gas pipe and the end is serrated, which can be done with an ordinary half-round or three-cornered file. In boring a hole, the end of the drill is tapped lightly with a hammer and turned slightly after every blow.

ANOTHER METHOD OF REDUCING THE RANGE OF A SPRINGFIELD RIFLE.

BY GEORGE E. HUGGINS.

On page 29 of the issue for January 9, 1909, there is an article on reducing the range of Springfield rifles. I think there is a better way.

First pull the ounce ball that comes in the loaded shells. Then clean out the powder, and reload with 20 grains if black powder is used. Cover this with a tight-fitting wad. Then fill the shell with fine sawdust, coarse cornmeal, or something of that nature. Next force in a round ball of 44 caliber with a patch of strong cloth that is thick enough to make a snug fit. The benefit of the patch is that it prevents leading of the rifling. The government loading tool crimps the shell at the muzzle. This crimp must be taken out before reloading the shell. The sawdust and wad clean the gun at every firing.

RECENTLY PATENTED INVENTIONS.

Of Interest to Farmers.

WRISTLET.—R. N. THOMAS, Shenandoah, Iowa. This wristlet comprises a sheet of flexible material such as leather, and is provided at one end near each side thereof with a series of four parallel slits, and straps are connected with the sheet by means of the slits. The straps are of sufficient length to pass entirely around the wrist when in place, and extend from their point of connection beneath the sheet and out through the opening, and thence around the outer surface of the wristlet to engagement with the buckle.

Of General Interest.

CABLE-GRIP.—T. W. TILEY, Bellingham, Wash. This invention relates to cable grips adapted for use in hauling logs and other loads. One object is to provide a grip having means which will grip the cable in an increasing degree as the load to be moved increases. Another object is to provide gripping means which are equally effective irrespective of the direction in which the cable is being hauled.

BAND-STAMP.—A. H. MERRILL, Ocean Springs, Miss. The stamp is especially adapted for use in entering lists of names on either books or papers, or both, as for instance pay rolls. In the present device a stamp is provided for each name and it is evident that the impression from each individual stamp may be repeated as many times as desired. In case the name of an employee is no longer used for any reason, it may be removed from the belt, and another substituted therefor.

ROAD-CULVERT.—L. BLAKESTAD and O. A. ANDERSON, Lyle, Minn. The improvement relates to road culverts and the object is to provide means for joining culvert members together, the means producing a much stronger culvert than other devices now in use. In this culvert the joints of the members are reinforced with cleats which are fastened together and are also fastened to the members.

SAND-BLAST APPARATUS.—D. A. NICHOLS, New York, N. Y. The purpose of the inventor is to provide a blast apparatus in which the flow of sand from the container or reservoir to the air blast pipe can be regulated and controlled with exactness, and in which the flow of the sand from the container is assisted by the equalizing pressure pipe communicating with the air blast pipe and discharging within the container near the top of the same.

Hardware.

BOARD-SETTING TOOL.—W. R. HARRIS, Pelican, La. More particularly the invention relates to board setting tools such as are adapted for the forcing of floor boards, ceiling boards, or the like, tightly together, and which are provided with levers carrying setting blocks and spurred body members adapted to engage the joists and pivotally to carry the levers.

Heating and Lighting.

GAS LIGHTING AND EXTINGUISHING APPARATUS.—O. H. HINDS, Le Mars, Iowa. By this invention, Mr. Hinds seeks to provide a novel construction whereby a temporary increase of pressure in the gas supply pipe or main may operate to open or close the supply valve leading to the burner or burners whereby the burner may be lighted or extinguished by the opening or closing of its supply valve.

Household Utilities.

BEDSTEAD.—G. T. BOUSLOG, Raymond, Miss. The invention relates to improvements in bedsteads, and more particularly in what are known as iron bedsteads, so that an adjustable post and rail construction is provided. The object is to provide a device which is provided with rails adapted to be horizontally adjusted with respect to the corner posts.

BATH-CABINET.—T. PAPWORTH, Portland, Ore. The object of the inventor is to provide a cabinet adapted to be removably mounted upon a bath-tub, and having an apron secured to the cover of the cabinet and depending into the tub to prevent water from escaping over the rim of the tub. Means provide for regulating the quantity of vapor within the cabinet, and controllable by the user from within the cabinet.

RECEPTACLE FOR MATCHES.—J. H. EVERS, New York, N. Y. One object of this improvement is to provide a receptacle which can be hung upon a wall or other support, or can be placed upon a table or the like, which is so formed that a telescopic box of matches can be inserted into the casing whereby it is opened to allow matches to drop into an open pocket from which they can be taken one at a time as needed.

Pertaining to Vehicles.

RIM-TIGHTENER FOR VEHICLE-WHEELS.—J. HAMILTON, Weir, Kan. The invention relates to wheels and improved means for tightening the rims. It comprehends means for securing together the abutting ends of the rim and for moving these ends relatively to each other for the purpose of tightening and loosening the rim in order to facilitate its removal, replacement, or its fitting while in position.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Notes and Queries.

Full hints to correspondents were printed at the head of this column in the issue of November 14 or will be sent by mail on request.

(12011) B. F. M. says: Please give me the best definition of the term "candle-power." We understand the relative meaning of candle-power to be the intensity of light as measured by the photometer on a horizontal plane one foot from the lamp, the same as given in all directions from the lamp, but how do we arrive at the phrase 16 candle-power, 32 candle-power, 50 candle-power, etc.? A. One candle is the light given by a standard candle. This is in England and America made of spermaceti, cylindrical in form, ⅞ inch in diameter, and of such a length that six weigh a pound. It burns 120 grains per hour. A 16-candle lamp gives 16 times as much light as this candle does at the same distance, or the same light at four times the distance. The word "power" has simply been attached to the name candle. It is not necessary. A lamp giving 16 candles is said to have 16 candle-power; that is, it is able to illuminate as well as 16 candles would do in the same place. It is not a unit of light. It is the unit of illuminating power.

(12012) J. J. G. asks: Will you kindly explain to me a phenomenon which I have noticed during the eclipse of the sun? At the time the sun is crescent shape, the light falling on the floor after having passed through a window-pane assumes the form of a multitude of crescents. I have never seen an explanation of this phenomenon. I have never seen even an indirect reference to it in any work on physics; but in a work published in 1852 by John Johnston entitled "Johnston's Natural Philosophy," at page 257, in discussing the passing of light through a small aperture a quarter of an inch square, this statement is made: "If these experiments are made during an eclipse of the sun the images will always be of the same form as the disk of the sun toward us." This is the nearest to a reference I have ever noticed. It may be that I have simply overlooked the reference, but it does not take up the question I asked of you, namely, why the light under these circumstances passing through a large glass window will throw thousands of such images on the floor. A. When the light from the sun passes through a small aperture and falls on the floor or any other flat surface nearly or quite perpendicular to the path of the rays of light, the disk seen is circular, since it is an image of the sun. The shape of the aperture through which the light comes does not affect the shape of the disk of light on the screen. The aperture may be triangular, square, round, irregular, or any other shape; the disk of light on the screen is circular when the sun's disk is a circle. The experiment may be performed with a gas burner, a small hole in a cardboard, and a white screen held in the path of the light beyond the cardboard. A very perfect image of the gas flame, inverted, will be found on the screen. The images cast through small apertures are of the same shape as the objects which cast the images. When the sun is in an eclipse the crescent-shaped sun may be seen repeated many times on the ground under trees, or on the floor of a room where the light enters through the crevices between the slats of blinds or other small openings. Ordinarily in the same situations circular disks, images of the sun, are formed. In the case mentioned above, the windows must have been rather dusty, so that the window became a series of small apertures in its effect upon the sunlight, and crescent images were seen. We should always see images of the sun on the floor but for the fact that they usually overlap each other. They are always there and may often be distinguished along the edges of a place where sunlight falls on the floor of a room. This matter is rarely mentioned in textbooks of physics now-a-days. The textbooks rarely give interesting applications of principles to occurrences in nature, but limit themselves quite too much to abstract statements of principles. Many textbooks are dry as dust for this reason. The case of images of the sun in an eclipse is to be found in Deschanel's "Natural Philosophy" under "Shadows." It would be a great improvement if all textbooks of science directed the attention of the student more to concrete applications of his study to be seen in nature, often close at hand, as in this particular case.

(12013) J. T. R. writes: I have a primary battery of eighteen cells; two series of nine connected in multiple, i.e., two positive and two negative wires connected. These are used to charge a secondary battery of three cells of chloride accumulator. The voltmeter indicates 6.6 volts at storage battery and 6.5 volts at terminals of primary battery. Is my primary battery large enough, and what should be the potential of the charging plant described above? A. A storage battery should have a charging current with a pressure of 2½ volts per cell. Three cells require 7½ volts. The maximum charging rate should be 6½ amperes per square foot of surface of positive plate, reckoning both sides. You probably fall short in both pressure and current.

NEW BOOKS, ETC.

AERIAL WARFARE. By R. P. Hearne. With an Introduction by Sir Hiram Maxim. New York: The John Lane Company, 1908. 8vo.; pp. 230. Price, $2.50 net.

This is an excellent volume, which goes into the construction and operation of the most successful aeroplanes and airships, and especially those used for military purposes. The author has a close acquaintance with the various air craft that have been developed during the past few years, and he describes them in a simple, non-technical manner, and tells of their performances. He afterward discusses their use in warfare, and the probable development that will be made in airships and heavier-than-air craft for this purpose. The author does not indulge in any flights of fancy, but he discusses in a sensible way the probable use that will be made of aerial craft in wars of the future. The book is illustrated with very fine halftone engravings, and it is in every respect a high-class volume.

DIE AUSNUTZUNG DER WASSERKRÄFTE. By E. Mattern. Leipzig: Wilhelm Engelmann, 1908. Imported by the Engineering News, New York. 650 pp.; 256 ill.

Making no attempt to be didactic or to draw any conclusions from his statements of fact, the author of this work aims chiefly at the compilation of statistics regarding striking modern developments in water-power work. Whereas the German and other European works naturally receive the most attention, those of both North and South America which involve any new departures are sufficiently covered, as well as the possibilities of the Zambesi in Africa, and the developments described in the book are as representative in their selection as their description has been thorough and complete.

THE MAN WHO ENDED WAR. By Hollis Godfrey. Boston: Little, Brown & Co. Price, $1.50.

Hollis Godfrey's "The Man Who Ended War" is the story of a monomaniac for peace, who brings about the general disarmament of nations through the destruction of their battleships by radiating a powerful gas which has the property of dissolving all metals into gas. The elaborate explanations of the manifestations of this new peculiar gas, and of the hero's scientific efforts to foil its employment, are crude and unconvincing even to one who is fond of pseudo-scientific romances. The human parts of the story are lacking in any delineation of character or of individual traits. All the leading personages in the story talk and act and feel just alike, whether they be hero or heroine, underling, or villain. The plot of this novel has the advantage of being more transparent than its descriptions of intricate scientific apparatus and of the reactions of molecules, atoms, electrocules, or the "original units that make up the world." Thus, any discerning reader is able to divine the hidden personality of "The Man Who Ended War" from the outset, so that there is no shock or surprise when the long-sought destroying angel finally reveals himself and drops dead in the act. At other points in the story, wherever any persons or objects are especially wanted, they usually turn up on the next page, and so it is with scientific manifestations.

THE LIFE OF SIR ISAAC PITMAN. By Alfred Baker. London: Isaac Pitman & Sons, 1908. 12mo.; 392 pp. Price, $2 net.

The "Father of Phonography" received a meager education, being compelled, on account of delicate health, to leave school at the age of thirteen, and his diligent and painstaking efforts to perfect himself in the use and pronunciation of English are brought out in a most interesting manner in this "Life." Pitman's first efforts in teaching shorthand and the circumstances which led to his inventing the modern system of "sound writing" are told in a comprehensive manner. Teachers of phonography will find this book invaluable, and it will inspire all students of stenography with a high regard for their chosen vocation and a desire to attain greater proficiency in this most useful profession. The book is fully illustrated with half-tones, engravings, and cuts showing the development of phonography.

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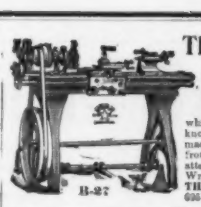

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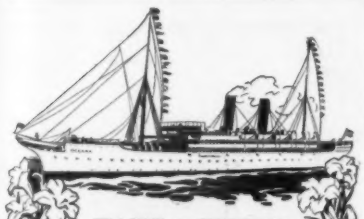

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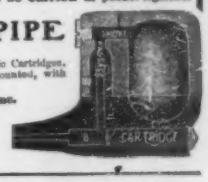

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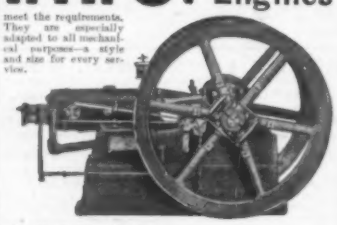

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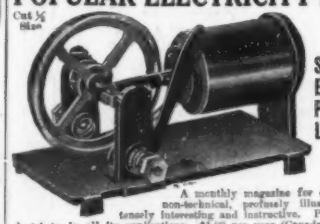

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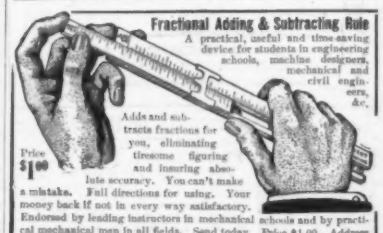

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